હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી

NAAC B (2.21) State University

પો.બો.નં.–૨૧, યુનિવર્સિટી રોડ, પાટણ (ઉ.ગુ.) ૩૮૪૨૬૫

ફોનઃ(૦૨૭૬૬) ૨૩૭૦૦૦

Email : regi@ngu.ac.in   Website : www.ngu.ac.in

પરિપત્ર નં.- ૧૪૦ /૨૦૨૬

વિષયઃ વિજ્ઞાન વિદ્યાશાખા હેઠળના અનુસ્નાતક કક્ષાના સેમેસ્ટર- ૦૧ થી ૦૪ ના શૈ.વર્ષ: ૨૦૨૬-૨૭ થી ક્રમશઃ અમલમાં આવતા અભ્યાસક્રમ / પરિક્ષા સ્કીમ અંગે.

આ યુનિવર્સિટી સંલગ્ન **વિજ્ઞાન** વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, એકેડેમિક કાઉન્સિલની તારીખઃ ૨૯/૦૬/૨૦૨૬ ના રોજ મળેલ સભાના નિર્દિષ્ટ ઠરાવોથી રાષ્ટ્રીય શિક્ષણ નીતિ-૨૦૨૦ અંતર્ગત UGCની Guideline મુજબ **વિજ્ઞાન** વિદ્યાશાખા હેઠળના નીચેના વિષયોના અનુસ્નાતક કક્ષાના સામેલ પરિશિષ્ટ પ્રમાણેના નવા અભ્યાસક્રમો સ્વીકારી શૈક્ષણિક વર્ષઃ ૨૦૨૬-૨૭ થી ક્રમશઃ અમલમાં આવે તે રીતે મંજુર કરેલ છે, જેનો અમલ કરવા સારૂ સબંધિતોને આ સાથે સામેલ રાખી મોકલવામાં આવે છે.

ક્રમ	અભ્યાસક્રમ	ઠરાવ ક્રમાંક	સેમેસ્ટર
૧	એમ. એસસી. રસાયણશાસ્ત્ર	૮.૧૮૮	સેમેસ્ટર ૧ થી ૪
૨	એમ.એસસી. ભૌતિકશાસ્ત્ર, ઇલેક્ટ્રોનિક્સ	૮.૧૯૦	સેમેસ્ટર ૧ થી ૪
૩	એમ. એસસી. વનસ્પતિશાસ્ત્ર	૮.૧૯૧	સેમેસ્ટર ૧ થી ૪
૪	એમ. એસસી. માઈક્રોબાયોલોજી	૮.૧૯૨	સેમેસ્ટર ૧ થી ૪
૫	એમ. એસસી. બાયોટેકનોલોજી	૮.૧૯૪	સેમેસ્ટર ૧ થી ૪
૬	એમ. એસસી. ગણિતશાસ્ત્ર	૮.૧૯૫	સેમેસ્ટર ૧ અને ૨
૭	એમ. એસસી. પ્રાણીશાસ્ત્ર	૮.૧૯૬	સેમેસ્ટર ૧ થી ૪
૮	એમ. એસસી. એન્વાયરમેન્ટલ સાયન્સ	૮.૧૯૭	સેમેસ્ટર ૧ થી ૪

સદર બાબતની જાણ આપના સ્તરેથી અધ્યાપકશ્રીઓ તથા વિદ્યાર્થીઓને કરવા વિનંતી છે.

નોંધઃ (૧) વિદ્યાર્થીઓની જરૂરીયાત માટે પરીપત્રની એક નકલ કોલેજના / ડિપાર્ટમેન્ટના ગ્રંથાલયમાં મૂકવાની રહેશે.

(૨) આ પરીપત્ર યુનિવર્સિટીની વેબસાઇટ www.ngu.ac.in પર પણ ઉપલબ્ધ કરવામાં આવેલ છે. આથી સંબિધત કોલેજોને ડાઉનલોડ કરી ઉપયોગ કરવા સારૂ જણાવવામાં આવે છે.

કુલસચિવ

બિડાણઃ ઉપર મુજબ

નં.એકે/સ.મં-૨/અXસ૨ ૫૭૭/૨૦૨૬

તા. ૧૪/૦૭/૨૦૨૬

નકલ રવાનાઃ (જાણ તથા ઘટતી કાર્યવાહી સારૂ) (By Email)

૧. ડીનશ્રી, ફેકલ્ટી ઓફ સાયન્સ, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.

૨. ચેરપર્સનશ્રી, વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ અભ્યાસ સમિતિ, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૩. વિજ્ઞાન વિદ્યાશાખા હેઠળની કોલેજોના આચાર્યશ્રીઓ તરફ
૪. પરીક્ષા નિયામકશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી પાટણ.
૫. કો-ઓર્ડીનેટરશ્રી- રાષ્ટ્રીય શિક્ષણ નીતિ-૨૦૨૦, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૬. ડાયરેક્ટરશ્રી – IQAC, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૭. ગ્રંથપાલશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી પાટણ.
૮. માન.કુલપતિશ્રી/કુલસચિવશ્રીનું કાર્યાલય હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી પાટણ.
૯. સિસ્ટમ એનાલીસ્ટશ્રી, કોમ્પ્યુટર (રીઝલ્ટ સેન્ટર) હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૧૦. પ્રવેશ પ્ર-શાખા, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ
૧૧. મહેકમ શાખા, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ. (૨ નકલ)

Hem.North Gujarat Uni.,PATAN

ANALYTICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY COURSE WORK PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(A)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(A)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(A)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26 PDSCC: CHE104(A)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(A)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(A)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(A)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(A)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(A)	Advanced Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE203(A)	Inorganic and Organic Spectroscopy	T	4	4	50	50

	DSCC4	SC2M26 PDSCC: CHE204(A)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(A)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(A)	SWAYAM (Select from portal)	T				
	SEC	SC2M26 SEC : CHE206(A)	Industrial chemistry based on Drugs	T	2	2	25	25
	VOC	SC2M26 VOC: CHE207(A)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(A)	Electrochemical and Thermogravimetric Methods of Chemical analysis	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(A)	Advanced Chromatographic Methods of Chemical Analysis and Analytical Method Development	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(A)	Bioanalytical Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE304(A)	Analytical Chemistry Practical 1	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(A)	Analytical Method Of Food	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE306(A)	Laboratory Practice Course	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(A)	Analytical Techniques of Forensic Science	T	2	2	25	25
IV	DSCC1	SC2M26DSCCCHE401(A)	Advanced Analytical Spectroscopic Techniques	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE402(A)	Chemical Methods of Pharmaceuticals and Polymer Analysis	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(A)	Laboratory Automation and Introduction to Cheminformatics	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE404(A)	Analytical chemistry	T	4	4	50	50

			Practical -||					
	DSEC1	**SC2M26DSECCHE405(A)**	**Analysis Of I**ndustrial and consumer product	T	**2**	**2**	**25**	**25**
	DSEC2	**SC2M26PDSECCHE406(A)**	Laboratory Practice Course	T	**2**	**2**	**25**	**25**
	DSEC3	**SC2M26DSECCHE407(A)**	Automation in Analytical Chemistry	T	**2**	**2**	**25**	**25**

Hem.North Gujarat Uni.,PATAN

ANALYTICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

COURSE WORK WITH RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(A)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(A)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(A)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(A)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(A)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(A)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(A)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(A)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(A)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(A)	**Inorganic and Organic Spectroscopy**	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(A)	**PRACTICAL**	P	4	4	50	50
	MDC	SC2M26M DC: CHE205(A)	**Chemistry of Catalysis**	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(A)	**SWAYAM (Select from portal)**	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(A)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(A)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(A)	**Electrochemical and Thermogravimetric Methods of Chemical analysis**	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(A)	**Advanced Chromatographic Methods of Chemical Analysis and Analytical Method Development**	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(A)	**Bioanalytical Chemistry**	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE304(A)	**Analytical Chemistry Practical 1**	T	4	4	50	50
	DSEC1	SC2M26DSCECCHE305(A)	**Analytical Method Of Food**	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE306(A)	**Laboratory Practice Course**	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(A)	**Analytical Techniques of Forensic Science**	T	2	2	25	25
IV	DSCC1	SC2MRPCHE401(A)	**Research Project**	P	16	16	200	200
	DSCC2	SC2MSCHE401(A)	**Seminar**	P	6	6	75	75

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ANALYTICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(A)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(A)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(A)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: 104(A)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(A)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(A)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(A)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(A)	Structure , Bonding and Spectroscopic Studies in	T	4	4	50	50

			Organic and Organo Metallic Chemistry					
	DSCC2	SC2M26 DSCC: CHE202(A)	**Advanced Physical Chemistry**	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE203(A)	**Inorganic and Organic Spectroscopy**	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(A)	**PRACTICAL**	P	4	4	50	50
	MDC	SC2M26M DC: CHE205(A)	**Chemistry of Catalysis**	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(A)	**SWAYAM (Select from portal)**	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(A)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(A)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2MRPCHE301(A)	Research Project	P	22	22	275	275
IV	DSCC1	SC2MRPCHE401(A)	Research Project	P	22	22	275	275

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Core Concepts in Organic and Coordination Chemistry

PROGRAMME CODE : DSCC 1

COURSE CODE : SC2M26 DSCC: CHE-101(A)

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand the fundamental principles of bonding in organic and coordination compounds.
- To develop knowledge of structure, reactivity, and stability of metal–ligand complexes.
- To analyze organic reaction mechanisms and factors influencing chemical reactions.
- To interpret spectroscopic techniques such as NMR for structural determination.
- To build problem-solving skills related to synthesis and chemical behavior.
- To apply theoretical concepts to practical and industrial chemical processes.

Course Outcomes

After completing this course, students will be able to:

- .* Explain the fundamental concepts of bonding in organic and coordination compounds.
- * Describe the structure, stability, and properties of metal–ligand complexes.
- * Analyze and predict organic reaction mechanisms and their outcomes.
- * Apply concepts of coordination and organic chemistry to solve chemical problems.
- * Demonstrate understanding of synthesis and reactivity in practical and industrial contexts

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stereochemistry and Bonding in Main Group Compounds**, VSEPR, Walsh diagrams (tri-and penta- atomic molecules), dπ-p π bonds, Bent rules and energetic of hybridization,	1	15

	some simple reactions of covalently bonded molecules.		
Unit - II	**Metal-Ligand Equilibrium** Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelae effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	1	15
Unit - III	**Nature of Bonding in organic Molecules** Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, enrgy level of pi-molecular orbital, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	1	15
Unit - IV	**Reaction Mechanism: Structure and Reactivity** Types of mechanism, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control, Hammond's postulate, CurtinHammett principle. Pottential energy diagrams, transition states and intermediates, methods of determining mechanisms isotope effects. Hard and soft acids and bases. Generation , Structure, stability and reacitivity of carbocations, carbanions, free radicals, Benzyne, carbenses and nitrenes. Effect of structure of reacitivity resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.	1	15

References: 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.

2. Inorganic Chemistry, J.E. Huhey, Harpes&Row.~

3. Chemistry of the Elements, vN.N. Greenwood and A. Earnshow, Pergamon.

4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.

5. Inorganic Chemistry by S.F.A.Cotton

6. Comprehensive Coordination Chemistryeds., G. Wilkinson, FLD.GillarsandJ.A McCleverty, Pergamon.

7. Advanced Organic Chemistry-Reactions, Mechanism and Structure, JerryMarch, Johri Wiley.

8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.

9. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

10. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.

11. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.

12. Modern Organic Reactions, H. O. House, Benjamin.

13. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.

14. Stereochemistry of Organic Compounds, D. Nasipuri, New AgeInte

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Advanced Concepts in Analytical and Physical Chemistry

PROGRAMME CODE : DSCC 2

COURSE CODE : SC2M26 DSCC: CHE-102 (A)

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

* To develop a deeper understanding of advanced analytical techniques and their applications.
* To study principles of thermodynamics and statistical mechanics in chemical systems.
* To understand redox processes, titration methods, and precipitation equilibria.
* To analyze chemical data and interpret experimental results accurately.
* To enhance problem-solving skills in physical and analytical chemistry contexts.
* To apply theoretical concepts to real-life laboratory and industrial situations.

Course Outcomes

After completing this course, students will be able to:

- * Apply advanced analytical techniques for qualitative and quantitative chemical analysis.
- * Explain principles of thermodynamics and statistical mechanics in chemical systems.
- * Analyze redox processes, titrations, and precipitation equilibria effectively.
- * Interpret experimental data and draw accurate scientific conclusions.
- * Solve complex problems related to physical and analytical chemistry.
- * Relate theoretical concepts to laboratory practices and industrial applications.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Statistical Thermodynamics** Introduction Combination and permutation Probability Sterling approximate formula (No Derivation) Type of Statistics Maxwell-Boltzmann Bose-Einstine Statistics Fermi-Dirac Statistics Partition Function Transnational Partition function Rotational Partition function Vibrantional Partition function Numericals	1	15

Unit – II	**Macromelecules** Classification of Polymers Tacticity of polymers. (Optical Isomers) Polymerization reaction with example - Addition Polymerization. (Polyethylene, Polystyrene,PVC) - Condensation Polymerization (Nylon-66, Dacron) Mechanisms of Polymerization Free radical chain Polymerization Anionic Polymerization Cationic Polymerization Kinctics of Free radical chain Polymerization Degree of Polymerization Molar masses of Polymer Number Average Molar Mass Weight Average Molar Mass Determination of Molar Masses of Macro Molecules Viscosity Method Light Scattering Method ,Numerical	1	15
Unit - III	**Redox titration:** Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors. Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants. Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of: (1) One electron system (2) Multi electron system, Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	1	15
Unit - IV	**Theory of precipitation:** Formation of precipitates, Particle size of precipitates, Impurities in precipitates, Purification of precipitates, Precipitation from homogeneous solution, Precipitation titrimetry, Mohr's method, Volhard method , Fajan method, construction of titration curve, Factors influencing the sharpness of end point	1	15

	Reference Books **1.Introduction to Modern Statistical Mechanics – by David Chandler** **2. Statistical Thermodynamics** **3. Thermodynamics and Statistical Thermodynamics** **4. Textbook of Polymer Science – by Fred W. Billmeyer Jr.** **5. Polymer Chemistry** **Principles of Polymerization – by George Odian** **6. Vogel's Textbook of Quantitative Chemical Analysis** **7. Fundamentals of Analytical Chemistry – by Douglas A. Skoog** **8. Quantitative Chemical Analysis – by Daniel C. Harris** **9. Quantitative Inorganic Analysis – by Arthur Israel Vogel** **10.Analytical Chemistry – by Gary D. Christian** **11. Instrumental Methods of Chemical Analysis**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Modern Approaches in Chemistry

PROGRAMME CODE : DSCC 3

COURSE CODE : SC2M26 DSCC: CHE-103(A)

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY(CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand emerging concepts and recent developments in different areas of chemistry.
  To learn advanced instrumental and analytical techniques used in modern research.
- To explore interdisciplinary applications in materials science, environmental, and biological chemistry.
- To develop skills in data analysis, interpretation, and scientific problem-solving.
- To enhance critical thinking and innovation in applying chemical knowledge.
- To apply modern chemical approaches to real-world and industrial challenges.

Course Outcomes

After successful completion of this course, students will be able to:

- * Understand and explain recent developments and emerging concepts in chemistry.
- * Apply advanced analytical and instrumental techniques in chemical analysis.
- * Integrate interdisciplinary knowledge in materials, environmental, and biological chemistry.
- * Analyze and interpret scientific data using modern methodologies.
- * Demonstrate critical thinking and problem-solving skills in complex chemical situations.
- * Apply innovative chemical approaches to research and real-world challenges.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stecreochemistry** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution optical purity, enantiotopic and diasterotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absensce of chiral carbon (biphenyls, allenes and spiranes) chirality due to helical shapes. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.	1	15

Unit - II	**Pericyclic Reactions** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Elecytrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systesms, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions, Sigmatropicrearrangements-suprafacial and antarafacial shifts of H, Sigmatropicshifs involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Copeand aza-Cope rearrangements. Fluxional tautomerism, Enereaction.	1	15
Unit - III	**Chromatographic methods**: General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equilibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.	1	15
Unit - IV	**Solvent Extraction Separation**: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency. SOLVENT EXTRACTION: Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction equilibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction	1	15
	REFERENCES **1. Stereochemistry of Organic Compounds: Principles and Applications – by D. Nasipuri** **2. Stereochemistry of Organic Compounds – by V. K. Ahluwalia** **3. Basic Stereochemistry of Organic Molecules – by Subrata Sengupta** **4. Stereochemistry of Organic Compounds – by Ernest L. Eliel and Samuel H. Wilen** **5. Stereochemistry and Organic Reactions – by Dipak K. Mandal** **6. Organic Stereochemistry – by Michael J. T. Robinson** **7. Introduction to Stereochemistry – by Kurt Mislow**		

	8. Essentials of Pericyclic and Photochemical Reactions by Biswanath Dinda **9. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach by Sunil Kumar, Vinod Kumar, and S. P. Singh** **10. Pericyclic Reactions & Organic Photochemistry by Vinay P. Sharma** **11. Pericyclic Reactions by Ian Fleming** **12. Pericyclic Reactions by G. B. Gill and M. R. Willis** **13. Advanced Organic Chemistry Part B: Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg** **14. Chromatography: Concepts and Contrasts Author: James M. Miller** **15. Chromatographic Methods Authors: A. Braithwaite & F.J. Smith** **16. Principles and Practice of Modern Chromatographic Methods Authors: Kevin Robards, Paul Haddad & Peter Jackson** **17.Chromatography Editor: Ivor Smith**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : PRACTICAL DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : PRACTICAL Discipline Specific Core Course: CHE104

PROGRAMME CODE : DSCC 4

COURSE CODE : SC2M26 PDSCC: CHE104(A)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Practical Discipline Specific Core Course (PDSCC 4)	4 Credit	25 CCE + 25 SEE =50	**SC2M26 PDSCC: CHE-104**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT CORE COURSE (PDSCC – 4)

1. **INORGANIC QUALITATIVE ANALYSIS HAVING SIX REDICALS** (MINIMUM EIGHT)
   (OUT OF SIX ONE MUST BE FROM RARE GROUP AND ONE MUST BE TRACE IN A MIXTURE)
   NEGATIVE REDICALS : Cl^-,Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1}$,PO_4^{-3},BO_3^{-3},CrO_4^{-2}
   POSSITIVE REDICALS : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   RARE : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   TRACE : Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1.}$

2. ORGANIC ISOLATION (ANY FOUR)

1. ISOLATION OF CURCUMIN FROM TURMERIC
2. ISOLATION OF EUGENOL FROM CINNAMON
3. ISOLATION ALOIN FROM ALOE
4. ISOLATION OF STARCH FROM POTATOES
5. ISOLATION OF PIPERINE FROM BLACK PAPER
6. ISOLATION OF CASIN FROM MILK

3. ORGANIC PREPARATION (ANY FOUR)

1. PHENYL ACETATE FROM PHENOL
2. RESACETOPHENON FROM RESORCINOL
3. DIAMINOBENZENE FROM ANILINE
4. SYM. TRI BROMO BENZENE FROM TRI BROMO ANILINE
5. META CHLORO NITRO BENZENE FROM META NITRO ANILINE
6. ETHYL CINNAMET FROM CINNAMIC ACID

4. PHYSICAL EXERCISE : (8 PRACTICALS)

(a) Chemical Kinetics

1. **Determine the effect of change in reactant concentration on the rate constant of hydrolysis of an ester/ionic reaction.**

2. **Determine the effect of change in temperature on the rate constant of hydrolysis of an ester/ionic reaction.**

(b) Instrumentationtal experiments

- **Cunductometry**

3. **Determine the normality and amount of ($HCl + H_2C_2O_4$) given solution by conductometric titration against 0.1 N sodium hydroxide.**
4. **Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurement and hence determine the energy of activation.**
5. **Analysis of aspirin (acetylsalicylic acid) by conductometric titration using 0.1 N NaOH / .1 N KOH**

- **Potentiometry**

6. **Determination of Halides-Determine the strength of halides in a mixture potentiometrically using 0.1 N AgNO3**
7. **To determine the instability constant of the silver-ammonia complex by potentiometry**

- **PH Metry**

8. **Determine the amount of aspirin (acetylsalicylic acid) in a tablet by pH-metric titration using 0.1 N NaOH / 0.1 N KOH**
9. **Determine the normality and amount of ($HCl + H_2C_2O_4$) a given solution by pH-metric titration against 0.1 N sodium hydroxide.**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : MULTI DISCIPLINE COURSE (THEORY)

COURSE NAME : **Industrial Chemistry based on Fibers and Dyes**
PROGRAMME CODE : **MDC 1**

COURSE CODE : **SC2M26 MDC:CHE-105(A)**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week: 02 Teaching Hours per Semester: 30	THEORY MULTI	External Marks (SEE) –25 Internal Marks (CCE) - 25

Course Objectives

* To understand the fundamentals of synthetic fibers and their properties.
* To study the chemistry, classification, and manufacturing of dyes.
* To learn dyeing techniques and interactions between dyes and fibers.
* To analyze industrial processes involved in fiber production and dye application.
* To understand environmental and safety aspects of dye and textile industries.
* To apply chemical knowledge to real-world textile and industrial applications.

Course Outcomes

* Classify natural and synthetic fibers and explain their properties.
* Describe the chemistry, types, and preparation of dyes.
* Explain dye–fiber interactions and various dyeing techniques.
* Analyze industrial processes used in fiber production and dye application.
* Evaluate environmental, safety, and pollution aspects of textile industries.
* Apply knowledge of fibers and dyes in practical and industrial contexts.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**<u>Industrial Chemistry based on synthetic fibers</u>** Definition, Ttypes of fibers, polymers and polymerisation, some important synthetic fibers, polyester, acrylic nylon, rayon, advantages ,disadvantages and their environmental impact’	1	15
Unit – II	**<u>Industrial Chemistry based on Dyes</u>** Introduction , types of common dyes ,characteristic of dyes, classification of dyes based on structure and application method.	1	15

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Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : PRACTICAL MULTI DISCIPLINE COURSE (Practical)

COURSE NAME : LABORATORY PRACTICAL COURSE

PROGRAMME CODE : MDC 2

COURSE CODE : SC2M26 PMDC: CHE-106(A)

(Effective from June 2026 under NEP-2020

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
MULTU Discipline Course (Practical) (PMDSC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE: (PMDC – Multi))

MULTIDISCIPLINE PRACTICAL **(TOTAL SIX : At least any two of each group)**

INORGANIC :

1. ALLOY analysis OF BRASS (Cu estimation by Sodium thiosulphate)
2. ALLOY analysis OF BRONZE (Cu estimation by Sodium thiosulphate)
3. ALLOY analysis OF GERMAN SILVER (Cu estimation by Sodium thiosulphate)

Organic :

4. ESTIMATION OF ASPIRIN in given sample
5. ESTIMATION OF ASCORBIC ACID in given sample
6. ESTIMATION OF PHENOL / ANILINE in given sample

Volumetric:

7. Amount determination Cu by EDTA volumetrically
8. Amount determination Zn by EDTA volumetrically
9. Amount determination Mg by EDTA volumetrically

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ANALYTICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : **VALUE ADDED COURSE (T)**
COURSE NAME : **FOOD CHEMISTRY**
PROGRAMME CODE : **VAC**

COURSE CODE : **SC2M26 VAC: CHE-107(A)**

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
VALUE ADDED COURSE (T) :(VAC)	2	25 CCE + 25 SEE =50	**SC2M26 VAC: CHE-107(A)**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Introduction to food Chemistry** Definition and Scope of Food Chemistry Composition of Foood Classification of Food Component Cabohydrates in Food Proteins in Food LIPID & Fats in Food Vitamins and Minerals in Food	1	15
Unit – II	**Food Additives** Introduction and Classification of Food Additives Food colorants ,Flavouring agents ,Sweeteners, imulsifyers and stabilizer and anti oxidant and preservatives	1	15

Hem.North Gujarat Uni.,PATAN

INDUSTRIAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY COURSE WORK PROGRAMME

SEMEST ER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HOURS / WE EK	CREDIT	INTERNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(IND)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(IND)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(IND)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26P DSCC: CHE104(IND)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(IND)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(IND)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(IND)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(IND)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(IND)	Advanced Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE203(IND)	Inorganic and Organic Spectroscopy	T	4	4	50	50

	DSCC4	SC2M26P DSCC: CHE204(IND)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26M DC: CHE205(IND)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(IND)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(IND)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(IND)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(IND)	Spectroscopy & Instrumental Techniques	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(IND)	Chemical Technology 1	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(IND)	Chemical Reaction Engineering & Utility Engineering	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE304(IND)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(IND)	Technology of Oleo chemicals	T	2	2	25	25
	DSEC2	SC2M26DSECCHE306(IND)	Environmental Chemistry	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(IND)	Industrial Management	T	2	2	25	25
IV	DSCC1	SC2M26DSCCCHE401(IND)	Chemical technology- 2	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE402(IND)	Industrial Hygiene & Safety	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(IND)	Petrochemicals	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE404(IND)	PRACTICAL	T	4	4	50	50
	DSEC1	SC2M26DSECCHE405(IND)	Process Safety Management	T	2	2	25	25
	DSEC2	SC2M26DSECCHE406(IND)	Industrial Pollution & Chemical Industrial Safety	T	2	2	25	25
	DSEC3	SC2M26DSECCHE407(IND)	Process Development in Chemical Industries	T	2	2	25	25

Hem.North Gujarat Uni.,PATAN

INDUSTRIAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

COURSE WORK WITH RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(IND)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(IND)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(IND)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(IND)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(IND)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(IND)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(IND)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(IND)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(IND)	Advanced Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE203(IND)	Inorganic and Organic	T	4	4	50	50

			Spectroscopy					
	DSCC4	SC2M26PDSCC: CHE204(IND)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(IND)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(IND)	SWAYAM (Select from portal)	T				
	SEC	SC2M26 SEC : CHE206(IND)	Industrial chemistry based on Drugs	T	2	2	25	25
	VOC	SC2M26 VOC: CHE207(IND)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(IND)	Spectroscopy & Instrumental Techniques	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(IND)	Chemical Technology 1	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(IND)	Chemical Reaction Engineering & Utility Engineering	T	4	4	50	50
	DSCC4	SC2M26DSCCCHE304(IND)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(IND)	Technology of Oleo chemicals	T	2	2	25	25
	DSEC2	SC2M26DSECCHE306(IND)	Environmental Chemistry	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(IND)	Industrial Management	T	2	2	25	25
IV	DSCC1	SC2MRPCHE401(IND)	Research Project	P	16	16	200	200
	DSCC2	SC2MSCHE401(IND)	Seminar	P	6	6	75	75

Hem.North Gujarat Uni.,PATAN

INDUSTRIAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTE RN A L MA RKS
I	DSCC1	SC2M26 DSCC: CHE101(IND)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(IND)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(IND)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCPC: CHE104(IND)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(IND)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(IND)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(IND)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(IND)	Structure , Bonding and Spectroscopic	T	4	4	50	50

			Studies in Organic and Organo Metallic Chemistry					
	DSCC2	**SC2M26 DSCC: CHE202(IND)**	**Advanced Physical Chemistry**	T	**4**	**4**	**50**	**50**
	DSCC3	**SC2M26 DSCC: CHE203(IND)**	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	**SC2M26PDSCC: CHE204(IND)**	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	**SC2M26M DC: CHE205(IND)**	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	**SC2M26 (Online) DSC:CHE-206(IND)**	**SWAYAM (Select from portal)**	T	**2**	**2**	**25**	**25**
	SEC	**SC2M26 SEC : CHE206(IND)**	Industrial chemistry based on Drugs	T				
	VOC	**SC2M26 VOC: CHE207(IND)**	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	**DSCC1**	**SC2MRPCHE301(IND)**	Research Project	P	22	22	275	275
IV	**DSCC1**	**SC2MRPCHE401(IND)**	Research Project	P	22	22	275	275

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Core Concepts in Organic and Coordination Chemistry**

PROGRAMME CODE : **DSCC 1**

COURSE CODE : **SC2M26 DSCC: CHE-101(IND)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand the fundamental principles of bonding in organic and coordination compounds.
- To develop knowledge of structure, reactivity, and stability of metal–ligand complexes.
- To analyze organic reaction mechanisms and factors influencing chemical reactions.
- To interpret spectroscopic techniques such as NMR for structural determination.
- To build problem-solving skills related to synthesis and chemical behavior.
- To apply theoretical concepts to practical and industrial chemical processes.

Course Outcomes

After completing this course, students will be able to:

- .* Explain the fundamental concepts of bonding in organic and coordination compounds.
- * Describe the structure, stability, and properties of metal–ligand complexes.
- * Analyze and predict organic reaction mechanisms and their outcomes.
- * Apply concepts of coordination and organic chemistry to solve chemical problems.
- * Demonstrate understanding of synthesis and reactivity in practical and industrial contexts

Unit No.	Content	Credit	Lect. Hrs 60

Unit-I	**Stereochemistry and Bonding in Main Group Compounds**, VSEPR, Walsh diagrams (tri-and penta- atomic molecules), $d\pi$-$p\ \pi$ bonds, Bent rules and energetic of hybridization, some simple reactions of covalently bonded molecules.	1	15
Unit - II	**Metal-Ligand Equilibrium** Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelae effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	1	15
Unit - III	**Nature of Bonding in organic Molecules** Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, enrgy level of pi-molecular orbital, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	1	15

Unit - IV	**Reaction Mechanism: Structure and Reactivity** Types of mechanism, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control, Hammond's postulate, CurtinHammett principle. Pottential energy diagrams, transition states and intermediates, methods of determining mechanisms isotope effects. Hard and soft acids and bases. Generation , Structure, stability and reacitivity of carbocations, carbanions, free radicals, Benzyne, carbenses and nitrenes. Effect of structure of reacitivity resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.	1	15
	References: 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. 2. Inorganic Chemistry, J.E. Huhey, Harpes&Row.~ 3. Chemistry of the Elements, vN.N. Greenwood and A. Earnshow, Pergamon. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. 5. Inorganic Chemistry by S.F.A.Cotton 6. Comprehensive Coordination Chemistryeds., G. Wilkinson, FLD.GillarsandJ.A McCleverty, Pergamon. 7. Advanced Organic Chemistry-Reactions, Mechanism and Structure, JerryMarch, Johri Wiley. 8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum. 9. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman. 10. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.		

	11. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall. 12. Modern Organic Reactions, H. O. House, Benjamin. 13. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan. 14. Stereochemistry of Organic Compounds, D. Nasipuri, New AgeInte		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Advanced Concepts in Analytical and Physical Chemistry**

PROGRAMME CODE : **DSCC 2**

COURSE CODE : **SC2M26 DSCC: CHE-102 (IND)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

* To develop a deeper understanding of advanced analytical techniques and their applications.
* To study principles of thermodynamics and statistical mechanics in chemical systems.
* To understand redox processes, titration methods, and precipitation equilibria.
* To analyze chemical data and interpret experimental results accurately.
* To enhance problem-solving skills in physical and analytical chemistry contexts.
* To apply theoretical concepts to real-life laboratory and industrial situations.

Course Outcomes

After completing this course, students will be able to:

- * Apply advanced analytical techniques for qualitative and quantitative chemical analysis.
- * Explain principles of thermodynamics and statistical mechanics in chemical systems.
- * Analyze redox processes, titrations, and precipitation equilibria effectively.
- * Interpret experimental data and draw accurate scientific conclusions.
- * Solve complex problems related to physical and analytical chemistry.
- * Relate theoretical concepts to laboratory practices and industrial applications.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Statistical Thermodynamics** Introduction Combination and permutation Probability Sterling approximate formula (No Derivation)	1	15

	Type of Statistics Maxwell-Boltzmann Bose-Einstine Statistics Fermi-Dirac Statistics Partition Function Transnational Partition function Rotational Partition function Vibrantional Partition function Numericals		
Unit – II	**<u>Macromelecules</u>** Classification of Polymers Tacticity of polymers. (Optical Isomers) Polymerization reaction with example - Addition Polymerization. (Polyethylene, Polystyrene,PVC) - Condensation Polymerization (Nylon-66, Dacron) Mechanisms of Polymerization Free radical chain Polymerization Anionic Polymerization Cationic Polymerization Kinctics of Free radical chain Polymerization Degree of Polymerization Molar masses of Polymer Number Average Molar Mass Weight Average Molar Mass Determination of Molar Masses of Macro Molecules Viscosity Method Light Scattering Method ,Numerical	1	15
Unit - III	**<u>Redox titration</u>:** Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors. Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants. Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of: (1) One electron system (2) Multi electron system, Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	1	15

Unit - IV	**<u>Theory of precipitation:</u>** Formation of precipitates, Particle size of precipitates, Impurities in precipitates, Purification of precipitates, Precipitation from homogeneous solution, Precipitation titrimetry, Mohr's method, Volhard method , Fajan method, construction of titration curve, Factors influencing the sharpness of end point	1	15
	Reference Books **1.Introduction to Modern Statistical Mechanics – by David Chandler** **2. Statistical Thermodynamics** **3. Thermodynamics and Statistical Thermodynamics** **4. Textbook of Polymer Science – by Fred W. Billmeyer Jr.** **5. Polymer Chemistry** **Principles of Polymerization – by George Odian** **6. Vogel's Textbook of Quantitative Chemical Analysis** **7. Fundamentals of Analytical Chemistry – by Douglas A. Skoog** **8. Quantitative Chemical Analysis – by Daniel C. Harris** **9. Quantitative Inorganic Analysis – by Arthur Israel Vogel** **10.Analytical Chemistry – by Gary D. Christian** **11. Instrumental Methods of Chemical Analysis**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Modern Approaches in Chemistry**

PROGRAMME CODE : DSCC 3

COURSE CODE : **SC2M26 DSCC: CHE-103(IND)**

(Effective from June 2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week: 04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY(CORE)</td><td>External Marks (SEE) - 50</td></tr>
<tr><td>Internal Marks (CCE) - 50</td></tr>
<tr><td colspan="3">Course Objectives
• To understand emerging concepts and recent developments in different areas of chemistry.
To learn advanced instrumental and analytical techniques used in modern research.
• To explore interdisciplinary applications in materials science, environmental, and biological chemistry.
• To develop skills in data analysis, interpretation, and scientific problem-solving.
• To enhance critical thinking and innovation in applying chemical knowledge.
• To apply modern chemical approaches to real-world and industrial challenges.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
• * Understand and explain recent developments and emerging concepts in chemistry.
• * Apply advanced analytical and instrumental techniques in chemical analysis.
• * Integrate interdisciplinary knowledge in materials, environmental, and biological chemistry.
• * Analyze and interpret scientific data using modern methodologies.
• * Demonstrate critical thinking and problem-solving skills in complex chemical situations.
• * Apply innovative chemical approaches to research and real-world challenges.</td></tr>
</table>

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stecreochemistry** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.	1	15

	Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution optical purity, enantiotopic and diasterotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absensce of chiral carbon (biphenyls, allenes and spiranes) chirality due to helical shapes. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.		
Unit - II	**<u>Pericyclic Reactions</u>** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Elecytrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions- antrafacial and suprafacial additions, 4n and 4n+2 systesms, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions, Sigmatropicrearrangements-suprafacial and antarafacial shifts of H, Sigmatropicshifs involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Copeand aza-Cope rearrangements. Fluxional tautomerism, Enereaction.	1	15
Unit - III	**<u>Chromatographic methods</u>**: General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equilibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.	1	15
Unit - IV	**<u>Solvent Extraction Separation</u>**: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency. SOLVENT EXTRACTION: Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction,	1	15

	Quantitative treatment of solvent Extraction equilibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction		
	REFERENCES **1. Stereochemistry of Organic Compounds: Principles and Applications – by D. Nasipuri** **2. Stereochemistry of Organic Compounds – by V. K. Ahluwalia** **3. Basic Stereochemistry of Organic Molecules – by Subrata Sengupta** **4. Stereochemistry of Organic Compounds – by Ernest L. Eliel and Samuel H. Wilen** **5. Stereochemistry and Organic Reactions – by Dipak K. Mandal** **6. Organic Stereochemistry – by Michael J. T. Robinson** **7. Introduction to Stereochemistry – by Kurt Mislow** **8. Essentials of Pericyclic and Photochemical Reactions by Biswanath Dinda** **9. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach by Sunil Kumar, Vinod Kumar, and S. P. Singh** **10. Pericyclic Reactions & Organic Photochemistry by Vinay P. Sharma** **11. Pericyclic Reactions by Ian Fleming** **12. Pericyclic Reactions by G. B. Gill and M. R. Willis** **13. Advanced Organic Chemistry Part B: Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg** **14. Chromatography: Concepts and Contrasts Author: James M. Miller** **15. Chromatographic Methods Authors: A. Braithwaite & F.J. Smith** **16. Principles and Practice of Modern Chromatographic Methods Authors: Kevin Robards, Paul Haddad & Peter Jackson** **17.Chromatography Editor: Ivor Smith**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : PRACTICAL DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : PRACTICAL Discipline Specific Core Course: CHE104

PROGRAMME CODE : SC2M26 PDSCC 4

COURSE CODE : SC2M26 PDSCC: CHE104(IND)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Practical Discipline Specific Core Course (PDSCC 4)	4 Credit	25 CCE + 25 SEE =50	**SC2M26 PDSCC: CHE-104**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT CORE COURSE (PDSCC – 4)

1. **INORGANIC QUALITATIVE ANALYSIS HAVING SIX REDICALS** (MINIMUM EIGHT)
   (OUT OF SIX ONE MUST BE FROM RARE GROUP AND ONE MUST BE TRACE IN A MIXTURE)
   NEGATIVE REDICALS : Cl^-,Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1}$,PO_4^{-3},BO_3^{-3},CrO_4^{-2}
   POSSITIVE REDICALS : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   RARE : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   TRACE : Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1.}$

2. ORGANIC ISOLATION (ANY FOUR)

1. ISOLATION OF CURCUMIN FROM TURMERIC
2. ISOLATION OF EUGENOL FROM CINNAMON
3. ISOLATION ALOIN FROM ALOE
4. ISOLATION OF STARCH FROM POTATOES
5. ISOLATION OF PIPERINE FROM BLACK PAPER
6. ISOLATION OF CASIN FROM MILK

3. ORGANIC PREPARATION (ANY FOUR)

1. PHENYL ACETATE FROM PHENOL
2. RESACETOPHENON FROM RESORCINOL
3. DIAMINOBENZENE FROM ANILINE

4. SYM. TRI BROMO BENZENE FROM TRI BROMO ANILINE
5. META CHLORO NITRO BENZENE FROM META NITRO ANILINE
6. ETHYL CINNAMET FROM CINNAMIC ACID

4. PHYSICAL EXERCISE : (8 PRACTICALS)

(a) Chemical Kinetics

1. Determine the effect of change in reactant concentration on the rate constant of hydrolysis of an ester/ionic reaction.

2. Determine the effect of change in temperature on the rate constant of hydrolysis of an ester/ionic reaction.

(b) Instrumentationtal experiments

- **Cunductometry**

3. Determine the normality and amount of ($HCl + H_2C_2O_4$) given solution by conductometric titration against 0.1 N sodium hydroxide.

4. Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurement and hence determine the energy of activation.

5. Analysis of aspirin (acetylsalicylic acid) by conductometric titration using 0.1 N NaOH / .1 N KOH

- **Potentiometry**

6. Determination of Halides-Determine the strength of halides in a mixture potentiometrically using 0.1 N AgNO3

7. To determine the instability constant of the silver-ammonia complex by potentiometry

- **PH Metry**

8. Determine the amount of aspirin (acetylsalicylic acid) in a tablet by pH-metric titration using 0.1 N NaOH / 0.1 N KOH

9. Determine the normality and amount of ($HCl + H_2C_2O_4$) a given solution by pH-metric titration against 0.1 N sodium hydroxide.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : MULTI DISCIPLINE COURSE (THEORY)

COURSE NAME : **Industrial Chemistry based on Fibers and Dyes**
PROGRAMME CODE : **MDC 1**

COURSE CODE : **SC2M26 MDC:CHE-105(IND)**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week: 02 Teaching Hours per Semester: 30	THEORY MULTI	External Marks (SEE) –25 Internal Marks (CCE) - 25
Course Objectives * To understand the fundamentals of synthetic fibers and their properties. * To study the chemistry, classification, and manufacturing of dyes. * To learn dyeing techniques and interactions between dyes and fibers. * To analyze industrial processes involved in fiber production and dye application. * To understand environmental and safety aspects of dye and textile industries. * To apply chemical knowledge to real-world textile and industrial applications.		
Course Outcomes * Classify natural and synthetic fibers and explain their properties. * Describe the chemistry, types, and preparation of dyes. * Explain dye–fiber interactions and various dyeing techniques. * Analyze industrial processes used in fiber production and dye application. * Evaluate environmental, safety, and pollution aspects of textile industries. * Apply knowledge of fibers and dyes in practical and industrial contexts.		

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Industrial Chemistry based on synthetic fibers** Definition, Ttypes of fibers, polymers and polymerisation, some important synthetic fibers, polyester, acrylic nylon, rayon, advantages ,disadvantages and their environmental	1	15

	impact’		
Unit – II	**<u>Industrial Chemistry based on Dyes</u>** Introduction , types of common dyes ,characteristic of dyes, classification of dyes based on structure and application method.	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : PRACTICAL MULTI DISCIPLINE COURSE (Practical)

COURSE NAME : LABORATORY PRACTICAL COURSE

PROGRAMME CODE : MDC 2

COURSE CODE : SC2M26 PMDC: CHE-106(IND)

(Effective from June 2026 under NEP-2020

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
MULTU Discipline Course (Practical) (PMDSC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE: (PMDC – Multi))

MULTIDISCIPLINE PRACTICAL **(TOTAL SIX : At least any two of each group)**

INORGANIC :

1. ALLOY analysis OF BRASS (Cu estimation by Sodium thiosulphate)
2. ALLOY analysis OF BRONZE (Cu estimation by Sodium thiosulphate)
3. ALLOY analysis OF GERMAN SILVER (Cu estimation by Sodium thiosulphate)

Organic :

4. ESTIMATION OF ASPIRIN in given sample
5. ESTIMATION OF ASCORBIC ACID in given sample
6. ESTIMATION OF PHENOL / ANILINE in given sample

Volumetric:

7. Amount determination Cu by EDTA volumetrically
8. Amount determination Zn by EDTA volumetrically
9. Amount determination Mg by EDTA volumetrically

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INDUSTRIAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : VALUE ADDED COURSE (T)
COURSE NAME : FOOD CHEMISTRY
PROGRAMME CODE : VAC

COURSE CODE : SC2M26 VAC: CHE-107(IND)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
VALUE ADDED COURSE (T) :(VAC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-105**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	<u>**Introduction to food Chemistry**</u> Definition and Scope of Food Chemistry Composition of Foood Classification of Food Component Cabohydrates in Food Proteins in Food LIPID & Fats in Food Vitamins and Minerals in Food	1	15
Unit – II	<u>**Food Additives**</u> Introduction and Classification of Food Additives Food colorants ,Flavouring agents ,Sweeteners, imulsifyers and stabilizer and anti oxidant and preservatives	1	15

Hem. North Gujarat Uni.,PATAN

INORGANIC CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY COURSE WORK PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(I)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(I)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(I)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(I)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(I)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(I)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(I)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(I)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(I)	Advanced Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE203(I)	Inorganic and Organic	T	4	4	50	50

			Spectroscopy					
	DSCC4	SC2M26PDSCC: CHE204(I)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(I)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(I)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(I)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(I)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(I)	Spectroscopic and Diffraction techniques in Inorganic Chemistry	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(I)	Advanced Inorganic Chemistry	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(I)	Corrosion Science or Coordination Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE304(I)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(I)	Inorganic Pharmaceutical & medicinal chemistry	T	2	2	25	25
	DSEC2	SC2M26DSECCHE306(I)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(I)	Environmental Chemistry	T	2	2	25	25
IV	DSCC1	SC2M26DSCCCHE401(I)	Advanced Spectroscopic Methods and Inorganic Photochemistry	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE402(I)	Advanced Coordination Chemistry and Inorganic Polymers	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(I)	Corrosion Science and Corrosion Control Technology	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(I)	Coordination Chemistry: Synthesis, Magneto Chemistry and Applications	T	4	4	50	50

	DSCC4	**SC2M26PDSCCCHE404(I)**	**Practical**	T	**4**	**4**	**50**	**50**
	DSEC1	**SC2M26DSECCHE405(I)**	**Bioinorganic Chemistry**	T	**2**	**2**	**25**	**25**
	DSEC2	**SC2M26DSECCHE406(I)**	**From Basket**	T	**2**	**2**	**25**	**25**
	DSEC3	**SC2M26DSECCHE407(I)**	**Industrial Applications of Inorganic Chemistry**	T	**2**	**2**	**25**	**25**

Hem.North Gujarat Uni.,PATAN

INORGANIC CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

COURSE WORK WITH RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(I)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(I)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(I)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(I)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(I)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(I)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(I)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(I)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(I)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(I)	Inorganic and Organic Spectroscopy	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(I)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(I)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(I)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(I)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(I)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(I)	Spectroscopic and Diffraction techniques in Inorganic Chemistry	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(I)	Advanced Inorganic Chemistry	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(I)	Corrosion Science or Coordination Chemistry	T	4	4	50	50
	DSCC4	SC2M26DSCCCHE304(I)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(I)	Inorganic Pharmaceutical & medicinal chemistry	T	2	2	25	25
	DSEC2	SC2M26DSECCHE306(I)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(I)	Environmental Chemistry	T	2	2	25	25
IV	DSCC1	SC2MRPCHE401(I)	Research Project	P	16	16	200	200
	DSCC2	SC2MSCHE401(I)	Seminar	P	6	6	75	75

Hem.North Gujarat Uni.,PATAN

INORGANIC CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HOUR S / WE EK	CRED IT	INTERNAL MARKS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(I)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(I)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(I)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCPC: CHE104(I)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(I)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(I)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(I)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(I)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(I)	Advanced Physical	T	4	4	50	50

			Chemistry					
	DSCC3	SC2M26 DSCC: CHE203(I)	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	SC2M26PDSCC: CHE204(I)	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	SC2M26MDC: CHE205(I)	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	SC2M26 (Online) DSC:CHE-206(I)	**SWAYAM (Select from portal)**	T				
	SEC	SC2M26 SEC : CHE206(I)	Industrial chemistry based on Drugs	T	**2**	**2**	**25**	**25**
	VOC	SC2M26 VOC: CHE207(I)	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	DSCC1	SC2MRPCHE301(I)	**Research Project**	P	22	22	275	275
IV	DSCC1	SC2MRPCHE401(I)	**Research Project**	P	22	22	275	275

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Core Concepts in Organic and Coordination Chemistry**

PROGRAMME CODE : **DSCC 1**

COURSE CODE : **SC2M26 DSCC: CHE-101(I)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand the fundamental principles of bonding in organic and coordination compounds.
- To develop knowledge of structure, reactivity, and stability of metal–ligand complexes.
- To analyze organic reaction mechanisms and factors influencing chemical reactions.
- To interpret spectroscopic techniques such as NMR for structural determination.
- To build problem-solving skills related to synthesis and chemical behavior.
- To apply theoretical concepts to practical and industrial chemical processes.

Course Outcomes

After completing this course, students will be able to:

- .* Explain the fundamental concepts of bonding in organic and coordination compounds.
- * Describe the structure, stability, and properties of metal–ligand complexes.
- * Analyze and predict organic reaction mechanisms and their outcomes.
- * Apply concepts of coordination and organic chemistry to solve chemical problems.
- * Demonstrate understanding of synthesis and reactivity in practical and industrial contexts

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stereochemistry and Bonding in Main Group**	1	15

	Compounds, VSEPR, Walsh diagrams (tri-and penta- atomic molecules), dπ-p π bonds, Bent rules and energetic of hybridization, some simple reactions of covalently bonded molecules.		
Unit - II	**Metal-Ligand Equilibrium** Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelae effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	1	15
Unit - III	**Nature of Bonding in organic Molecules** Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, enrgy level of pi-molecular orbital, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	1	15
Unit - IV	**Reaction Mechanism: Structure and Reactivity** Types of mechanism, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control, Hammond's postulate, CurtinHammett principle. Pottential energy diagrams, transition states and intermediates, methods of determining mechanisms isotope effects. Hard and soft acids and bases. Generation , Structure, stability and reacitivity of carbocations, carbanions, free radicals, Benzyne, carbenses and nitrenes. Effect of structure of reacitivity resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.	1	15

	References: 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. 2. Inorganic Chemistry, J.E. Huhey, Harpes&Row.~ 3. Chemistry of the Elements, vN.N. Greenwood and A. Earnshow, Pergamon. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. 5. Inorganic Chemistry by S.F.A.Cotton 6. Comprehensive Coordination Chemistryeds., G. Wilkinson, FLD.GillarsandJ.A McCleverty, Pergamon. 7. Advanced Organic Chemistry-Reactions, Mechanism and Structure, JerryMarch, Johri Wiley. 8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum. 9. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman. 10. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press. 11. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall. 12. Modern Organic Reactions, H. O. House, Benjamin. 13. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan. 14. Stereochemistry of Organic Compounds, D. Nasipuri, New AgeInte		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Advanced Concepts in Analytical and Physical Chemistry**

PROGRAMME CODE : **DSCC 2**

COURSE CODE : **SC2M26 DSCC: CHE-102 (I)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

* To develop a deeper understanding of advanced analytical techniques and their applications.
* To study principles of thermodynamics and statistical mechanics in chemical systems.
* To understand redox processes, titration methods, and precipitation equilibria.
* To analyze chemical data and interpret experimental results accurately.
* To enhance problem-solving skills in physical and analytical chemistry contexts.
* To apply theoretical concepts to real-life laboratory and industrial situations.

Course Outcomes

After completing this course, students will be able to:

- * Apply advanced analytical techniques for qualitative and quantitative chemical analysis.
- * Explain principles of thermodynamics and statistical mechanics in chemical systems.
- * Analyze redox processes, titrations, and precipitation equilibria effectively.
- * Interpret experimental data and draw accurate scientific conclusions.
- * Solve complex problems related to physical and analytical chemistry.
- * Relate theoretical concepts to laboratory practices and industrial applications.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Statistical Thermodynamics** Introduction Combination and permutation Probability Sterling approximate formula (No Derivation)	1	15

	Type of Statistics Maxwell-Boltzmann Bose-Einstine Statistics Fermi-Dirac Statistics Partition Function Transnational Partition function Rotational Partition function Vibrantional Partition function Numericals		
Unit – II	**<u>Macromelecules</u>** Classification of Polymers Tacticity of polymers. (Optical Isomers) Polymerization reaction with example - Addition Polymerization. (Polyethylene, Polystyrene,PVC) - Condensation Polymerization (Nylon-66, Dacron) Mechanisms of Polymerization Free radical chain Polymerization Anionic Polymerization Cationic Polymerization Kinctics of Free radical chain Polymerization Degree of Polymerization Molar masses of Polymer Number Average Molar Mass Weight Average Molar Mass Determination of Molar Masses of Macro Molecules Viscosity Method Light Scattering Method ,Numerical	1	15
Unit - III	**<u>Redox titration</u>:** Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors. Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants. Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of: (1) One electron system (2) Multi electron system, Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	1	15

Unit - IV	<u>**Theory of precipitation:**</u> Formation of precipitates, Particle size of precipitates, Impurities in precipitates, Purification of precipitates, Precipitation from homogeneous solution, Precipitation titrimetry, Mohr's method, Volhard method , Fajan method, construction of titration curve, Factors influencing the sharpness of end point	1	15
	Reference Books **1.Introduction to Modern Statistical Mechanics – by David Chandler** **2. Statistical Thermodynamics** **3. Thermodynamics and Statistical Thermodynamics** **4. Textbook of Polymer Science – by Fred W. Billmeyer Jr.** **5. Polymer Chemistry** **Principles of Polymerization – by George Odian** **6. Vogel's Textbook of Quantitative Chemical Analysis** **7. Fundamentals of Analytical Chemistry – by Douglas A. Skoog** **8. Quantitative Chemical Analysis – by Daniel C. Harris** **9. Quantitative Inorganic Analysis – by Arthur Israel Vogel** **10.Analytical Chemistry – by Gary D. Christian** **11. Instrumental Methods of Chemical Analysis**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Modern Approaches in Chemistry

PROGRAMME CODE : DSCC 3

COURSE CODE : SC2M26 DSCC: CHE-103(I)

(Effective from June 2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week: 04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY(CORE)</td><td>External Marks (SEE) - 50</td></tr>
<tr><td>Internal Marks (CCE) - 50</td></tr>
<tr><td colspan="3">Course Objectives
• To understand emerging concepts and recent developments in different areas of chemistry.
To learn advanced instrumental and analytical techniques used in modern research.
• To explore interdisciplinary applications in materials science, environmental, and biological chemistry.
• To develop skills in data analysis, interpretation, and scientific problem-solving.
• To enhance critical thinking and innovation in applying chemical knowledge.
• To apply modern chemical approaches to real-world and industrial challenges.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
• * Understand and explain recent developments and emerging concepts in chemistry.
• * Apply advanced analytical and instrumental techniques in chemical analysis.
• * Integrate interdisciplinary knowledge in materials, environmental, and biological chemistry.
• * Analyze and interpret scientific data using modern methodologies.
• * Demonstrate critical thinking and problem-solving skills in complex chemical situations.
• * Apply innovative chemical approaches to research and real-world challenges.</td></tr>
</table>

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**<u>Stecreochemistry</u>** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers,	1	15

	methods of resolution optical purity, enantiotopic and diasterotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absensce of chiral carbon (biphenyls, allenes and spiranes) chirality due to helical shapes. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.		
Unit - II	**<u>Pericyclic Reactions</u>** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Elecytrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systesms, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions, Sigmatropicrearrangements-suprafacial and antarafacial shifts of H, Sigmatropicshifs involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Copeand aza-Cope rearrangements. Fluxional tautomerism, Enereaction.	1	15
Unit - III	**<u>Chromatographic methods</u>**: General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equilibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.	1	15
Unit - IV	**<u>Solvent Extraction Separation</u>**: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency. SOLVENT EXTRACTION: Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction equilibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction	1	15

	REFERENCES **1. Stereochemistry of Organic Compounds: Principles and Applications – by D. Nasipuri** **2. Stereochemistry of Organic Compounds – by V. K. Ahluwalia** **3. Basic Stereochemistry of Organic Molecules – by Subrata Sengupta** **4. Stereochemistry of Organic Compounds – by Ernest L. Eliel and Samuel H. Wilen** **5. Stereochemistry and Organic Reactions – by Dipak K. Mandal** **6. Organic Stereochemistry – by Michael J. T. Robinson** **7. Introduction to Stereochemistry – by Kurt Mislow** **8. Essentials of Pericyclic and Photochemical Reactions by Biswanath Dinda** **9. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach by Sunil Kumar, Vinod Kumar, and S. P. Singh** **10. Pericyclic Reactions & Organic Photochemistry by Vinay P. Sharma** **11. Pericyclic Reactions by Ian Fleming** **12. Pericyclic Reactions by G. B. Gill and M. R. Willis** **13. Advanced Organic Chemistry Part B: Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg** **14. Chromatography: Concepts and Contrasts Author: James M. Miller** **15. Chromatographic Methods Authors: A. Braithwaite & F.J. Smith** **16. Principles and Practice of Modern Chromatographic Methods Authors: Kevin Robards, Paul Haddad & Peter Jackson** **17.Chromatography Editor: Ivor Smith**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : PRACTICAL DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : PRACTICAL Discipline Specific Core Course: CHE104

PROGRAMME CODE : DSCC 4

COURSE CODE : SC2M26 PDSCC: CHE104(I)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Practical Discipline Specific Core Course (PDSCC 4)	4 Credit	25 CCE + 25 SEE =50	**SC2M26 PDSCC: CHE-104**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT CORE COURSE (PDSCC – 4)

1. **INORGANIC QUALITATIVE ANALYSIS HAVING SIX REDICALS** (MINIMUM EIGHT)
   (OUT OF SIX ONE MUST BE FROM RARE GROUP AND ONE MUST BE TRACE IN A MIXTURE)
   NEGATIVE REDICALS : Cl^{-},Br^{-},I^{-},CO_3^{-2},NO_3^{-1},$N0_2^{-1}$,PO_4^{-3},BO_3^{-3},CrO_4^{-2}
   POSSITIVE REDICALS : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   RARE : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   TRACE : Br^{-},I^{-},CO_3^{-2},NO_3^{-1},$N0_2^{-1.}$

2. ORGANIC ISOLATION (ANY FOUR)

1. ISOLATION OF CURCUMIN FROM TURMERIC
2. ISOLATION OF EUGENOL FROM CINNAMON
3. ISOLATION ALOIN FROM ALOE
4. ISOLATION OF STARCH FROM POTATOES
5. ISOLATION OF PIPERINE FROM BLACK PAPER
6. ISOLATION OF CASIN FROM MILK

3. ORGANIC PREPARATION (ANY FOUR)

1. PHENYL ACETATE FROM PHENOL
2. RESACETOPHENON FROM RESORCINOL

3. DIAMINOBENZENE FROM ANILINE
4. SYM. TRI BROMO BENZENE FROM TRI BROMO ANILINE
5. META CHLORO NITRO BENZENE FROM META NITRO ANILINE
6. ETHYL CINNAMET FROM CINNAMIC ACID

4. PHYSICAL EXERCISE : (8 PRACTICALS)

(a) Chemical Kinetics

1. **Determine the effect of change in reactant concentration on the rate constant of hydrolysis of an ester/ionic reaction.**
2. **Determine the effect of change in temperature on the rate constant of hydrolysis of an ester/ionic reaction.**

(b) Instrumentationtal experiments

- **Cunductometry**

3. **Determine the normality and amount of (HCl + $H_2C_2O_4$) given solution by conductometric titration against 0.1 N sodium hydroxide.**
4. **Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurement and hence determine the energy of activation.**
5. **Analysis of aspirin (acetylsalicylic acid) by conductometric titration using 0.1 N NaOH / .1 N KOH**

- **Potentiometry**

6. **Determination of Halides-Determine the strength of halides in a mixture potentiometrically using 0.1 N AgNO3**
7. **To determine the instability constant of the silver-ammonia complex by potentiometry**

- **PH Metry**

8. **Determine the amount of aspirin (acetylsalicylic acid) in a tablet by pH-metric titration using 0.1 N NaOH / 0.1 N KOH**
9. **Determine the normality and amount of (HCl + $H_2C_2O_4$) a given solution by pH-metric titration against 0.1 N sodium hydroxide.**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER - I

TYPE OF COURSE : MULTI DISCIPLINE COURSE (THEORY)

COURSE NAME : **Industrial Chemistry based on Fibers and Dyes**
PROGRAMME CODE : **MDC 1**

COURSE CODE : **SC2M26 MDC:CHE-105(I)**

(Effective from June 2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 02
Teaching Hours per Week: 02
Teaching Hours per Semester: 30</td><td rowspan="2">THEORY MULTI</td><td>External Marks (SEE) –25</td></tr>
<tr><td>Internal Marks (CCE) - 25</td></tr>
<tr><td colspan="3">Course Objectives
* To understand the fundamentals of synthetic fibers and their properties.
* To study the chemistry, classification, and manufacturing of dyes.
* To learn dyeing techniques and interactions between dyes and fibers.
* To analyze industrial processes involved in fiber production and dye application.
* To understand environmental and safety aspects of dye and textile industries.
* To apply chemical knowledge to real-world textile and industrial applications.</td></tr>
<tr><td colspan="3">Course Outcomes
* Classify natural and synthetic fibers and explain their properties.
* Describe the chemistry, types, and preparation of dyes.
* Explain dye–fiber interactions and various dyeing techniques.
* Analyze industrial processes used in fiber production and dye application.
* Evaluate environmental, safety, and pollution aspects of textile industries.
* Apply knowledge of fibers and dyes in practical and industrial contexts.</td></tr>
</table>

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Industrial Chemistry based on synthetic fibers** Definition, Ttypes of fibers, polymers and polymerisation, some important synthetic fibers, polyester, acrylic nylon, rayon, advantages ,disadvantages and their environmental impact’	1	15
	Industrial Chemistry based on Dyes	1	15

Unit – II	Introduction , types of common dyes ,characteristic of dyes, classification of dyes based on structure and application method.		

) **HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER - I

TYPE OF COURSE : PRACTICAL MULTI DISCIPLINE COURSE (Practical)

COURSE NAME : LABORATORY PRACTICAL COURSE

PROGRAMME CODE : MDC 2

COURSE CODE : SC2M26 PMDC: CHE-106(I)

(Effective from June 2026 under NEP-2020

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
MULTU Discipline Course (Practical) (PMDSC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE: (PMDC – Multi))

MULTIDISCIPLINE PRACTICAL **(TOTAL SIX : At least any two of each group)**

INORGANIC :

1. ALLOY analysis OF BRASS (Cu estimation by Sodium thiosulphate)
2. ALLOY analysis OF BRONZE (Cu estimation by Sodium thiosulphate)
3. ALLOY analysis OF GERMAN SILVER (Cu estimation by Sodium thiosulphate)

Organic :

4. ESTIMATION OF ASPIRIN in given sample
5. ESTIMATION OF ASCORBIC ACID in given sample
6. ESTIMATION OF PHENOL / ANILINE in given sample

Volumetric:

7. Amount determination Cu by EDTA volumetrically
8. Amount determination Zn by EDTA volumetrically
9. Amount determination Mg by EDTA volumetrically

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. INORGANIC CHEMISTRY: SEMESTER - I

TYPE OF COURSE : VALUE ADDED COURSE (T)
COURSE NAME : FOOD CHEMISTRY
PROGRAMME CODE : VAC

COURSE CODE : SC2M26 VAC: CHE-107(I)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
VALUE ADDED COURSE (T) :(VAC)	2	25 CCE + 25 SEE =50	**SC2M26 VAC: CHE-107(I)**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Introduction to food Chemistry** Definition and Scope of Food Chemistry Composition of Foood Classification of Food Component Cabohydrates in Food Proteins in Food LIPID & Fats in Food Vitamins and Minerals in Food	1	15
Unit – II	**Food Additives** Introduction and Classification of Food Additives Food colorants ,Flavouring agents ,Sweeteners, imulsifyers and stabilizer and anti oxidant and preservatives	1	15

Hem.North Gujarat Uni.,PATAN

ORGANIC CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

<u>ONLY COURSE WORK PROGRAMME</u>

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(O)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(O)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(O)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(O)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(O)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(O)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(O)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(O)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(O)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(O)	Inorganic and Organic Spectroscopy	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(O)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(O)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(O)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(O)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(O)	Waste management and recycling of chemical	T	2	2	25	25
	DSCC1	SC2M26DSCCCHE301(O)	Natural Products	T	4	4	50	50
III	DSCC2	SC2M26DSCCCHE302(O)	Industrial Chemistry	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(O)	Synthetic Drugs-1	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE304(O)	Organic Chemistry Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(O)	Heterocyclic Chemistry	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE306(O)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(O)	Organic Photo Chemistry	T	2	2	25	25
	DSCC1	SC2M26DSCCCHE401(O)	Natural Products and Stereo Chemistry	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE402(O)	Industrial Organic Chemistry	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(O)	Synthetic Drugs-2	T	4	4	50	50
IV	DSCC4	SC2M26PDSCCCHE404(O)	Organic chemistry Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE405(O)	Molecular Rearrangement	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE406(O)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE407(O)	Organic Disconnection Approach	T	2	2	25	25

Hem.North Gujarat Uni.,PATAN

ORGANIC CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

COURSE WORK WITH RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(O)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(O)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(O)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(O)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(O)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(O)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(O)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(O)	Structure , Bonding and Spectroscopic Studies in Organic and Organo	T	4	4	50	50

			Metallic Chemistry					
	DSCC2	**SC2M26 DSCC: CHE202(O)**	**Advanced Physical Chemistry**	T	**4**	**4**	**50**	**50**
	DSCC3	**SC2M26 DSCC: CHE203(O)**	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	**SC2M26PDSCC: CHE204(O)**	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	**SC2M26MDC: CHE205(O)**	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	**SC2M26 (Online) DSC:CHE-206(O)**	**SWAYAM (Select from portal)**	T	**2**	**2**	**25**	**25**
	SEC	**SC2M26 SEC : CHE206(O)**	Industrial chemistry based on Drugs	T				
	VOC	**SC2M26 VOC: CHE207(O)**	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	DSCC1	**SC2M26DSCCCHE301(O)**	**Natural Products and Stereo Chemistry**	T	**4**	**4**	**50**	**50**
	DSCC2	**SC2M26DSCCCHE302(O)**	**Industrial Chemistry**	T	**4**	**4**	**50**	**50**
	DSCC3	**SC2M26DSCCCHE303(O)**	**Synthetic Drugs-1**	T	**4**	**4**	**50**	**50**
	DSCC4	**SC2M26DSCCCHE304(O)**	**Organic Chemistry Practical**	T	**4**	**4**	**50**	**50**
	DSEC1	**SC2M26DSECCHE305(O)**	**Heterocyclic Chemistry**	T	**2**	**2**	**25**	**25**
	DSEC2	**SC2M26PDSECCHE306(O)**	**Practical**	T	**2**	**2**	**25**	**25**
	DSEC3	**SC2M26DSECCHE307(O)**	**Organic Photo Chemistry**	T	**2**	**2**	**25**	**25**
IV	**DSCC1**	**SC2MRPCHE401(O)**	**Research Project**	P	**16**	**16**	**200**	**200**
	DSCC2	**SC2MSCHE401(O)**	**Seminar**	P	**6**	**6**	**75**	**75**

Hem.North Gujarat Uni.,PATAN

ORGANIC CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(O)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(O)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(O)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26P DSCPC: CHE104(O)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(O)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(O)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(O)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(O)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(O)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(O)	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	SC2M26PDSCC: CHE204(O)	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	SC2M26MDC: CHE205(O)	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	SC2M26 (Online) DSC:CHE-206(O)	**SWAYAM (Select from portal)**	T	**2**	**2**	**25**	**25**
	SEC	SC2M26 SEC : CHE206(O)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(O)	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	DSCC1	SC2MRPCHE301(O)	**Research Project**	P	22	22	275	275
IV	DSCC1	SC2MRPCHE401(O)	**Research Project**	P	22	22	275	275

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Core Concepts in Organic and Coordination Chemistry**

PROGRAMME CODE : **DSCC 1**

COURSE CODE : **SC2M26 DSCC: CHE-101(O)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 **Teaching Hours per Week: 04** **Teaching Hours per Semester: 60**	**THEORY (CORE)**	**External Marks (SEE) - 50** **Internal Marks (CCE) - 50**

Course Objectives

- To understand the fundamental principles of bonding in organic and coordination compounds.
- To develop knowledge of structure, reactivity, and stability of metal–ligand complexes.
- To analyze organic reaction mechanisms and factors influencing chemical reactions.
- To interpret spectroscopic techniques such as NMR for structural determination.
- To build problem-solving skills related to synthesis and chemical behavior.
- To apply theoretical concepts to practical and industrial chemical processes.

Course Outcomes

After completing this course, students will be able to:

- .* Explain the fundamental concepts of bonding in organic and coordination compounds.
- * Describe the structure, stability, and properties of metal–ligand complexes.
- * Analyze and predict organic reaction mechanisms and their outcomes.
- * Apply concepts of coordination and organic chemistry to solve chemical problems.
- * Demonstrate understanding of synthesis and reactivity in practical and industrial contexts

Unit No.	Content	Credit	Lect. Hrs 60

Unit-I	**Stereochemistry and Bonding in Main Group Compounds**, VSEPR, Walsh diagrams (tri-and penta- atomic molecules), $d\pi$-p π bonds, Bent rules and energetic of hybridization, some simple reactions of covalently bonded molecules.	1	15
Unit - II	**Metal-Ligand Equilibrium** Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelae effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	1	15
Unit - III	**Nature of Bonding in organic Molecules** Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, enrgy level of pi-molecular orbital, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	1	15
Unit - IV	**Reaction Mechanism: Structure and Reactivity** Types of mechanism, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control, Hammond's postulate, CurtinHammett principle. Pottential energy diagrams, transition states and intermediates, methods of determining mechanisms isotope effects. Hard and soft acids and bases. Generation , Structure, stability and reacitivity of carbocations, carbanions, free radicals, Benzyne, carbenses and nitrenes. Effect of structure of reacitivity resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.	1	15

References: 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.

2. Inorganic Chemistry, J.E. Huhey, Harpes&Row.~

3. Chemistry of the Elements, vN.N. Greenwood and A. Earnshow, Pergamon.

4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Inorganic Chemistry by S.F.A.Cotton
6. Comprehensive Coordination Chemistryeds., G. Wilkinson, FLD.GillarsandJ.A McCleverty, Pergamon.

7. Advanced Organic Chemistry-Reactions, Mechanism and Structure, JerryMarch, Johri Wiley.

8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.

9. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

10. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.

11. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.

12. Modern Organic Reactions, H. O. House, Benjamin.

13. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.

14. Stereochemistry of Organic Compounds, D. Nasipuri, New AgeInte

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Advanced Concepts in Analytical and Physical Chemistry**

PROGRAMME CODE : **DSCC 2**

COURSE CODE : **SC2M26 DSCC: CHE-102 (O)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 **Teaching Hours per Week: 04** **Teaching Hours per Semester: 60**	**THEORY (CORE)**	**External Marks (SEE) - 50** **Internal Marks (CCE) - 50**

Course Objectives

* To develop a deeper understanding of advanced analytical techniques and their applications.
* To study principles of thermodynamics and statistical mechanics in chemical systems.
* To understand redox processes, titration methods, and precipitation equilibria.
* To analyze chemical data and interpret experimental results accurately.
* To enhance problem-solving skills in physical and analytical chemistry contexts.
* To apply theoretical concepts to real-life laboratory and industrial situations.

Course Outcomes

After completing this course, students will be able to:

- * Apply advanced analytical techniques for qualitative and quantitative chemical analysis.
- * Explain principles of thermodynamics and statistical mechanics in chemical systems.
- * Analyze redox processes, titrations, and precipitation equilibria effectively.
- * Interpret experimental data and draw accurate scientific conclusions.
- * Solve complex problems related to physical and analytical chemistry.
- * Relate theoretical concepts to laboratory practices and industrial applications.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Statistical Thermodynamics** Introduction Combination and permutation Probability Sterling approximate formula (No Derivation) Type of Statistics Maxwell-Boltzmann Bose-Einstine Statistics Fermi-Dirac Statistics Partition Function	1	15

	Transnational Partition function Rotational Partition function Vibrantional Partition function Numericals		
Unit – II	**<u>Macromelecules</u>** Classification of Polymers Tacticity of polymers. (Optical Isomers) Polymerization reaction with example - Addition Polymerization. (Polyethylene, Polystyrene,PVC) - Condensation Polymerization (Nylon-66, Dacron) Mechanisms of Polymerization Free radical chain Polymerization Anionic Polymerization Cationic Polymerization Kinctics of Free radical chain Polymerization Degree of Polymerization Molar masses of Polymer Number Average Molar Mass Weight Average Molar Mass Determination of Molar Masses of Macro Molecules Viscosity Method Light Scattering Method ,Numerical	1	15
Unit - III	**<u>Redox titration</u>:** Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors. Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants. Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of: (1) One electron system (2) Multi electron system, Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	1	15
Unit - IV	**<u>Theory of precipitation:</u>** Formation of precipitates, Particle size of precipitates, Impurities in precipitates, Purification of precipitates, Precipitation from homogeneous solution, Precipitation titrimetry, Mohr's method, Volhard method , Fajan method, construction of titration curve, Factors influencing the sharpness of end point	1	15

	Reference Books **1.Introduction to Modern Statistical Mechanics – by David Chandler** **2. Statistical Thermodynamics** **3. Thermodynamics and Statistical Thermodynamics** **4. Textbook of Polymer Science – by Fred W. Billmeyer Jr.** **5. Polymer Chemistry** **Principles of Polymerization – by George Odian** **6. Vogel's Textbook of Quantitative Chemical Analysis** **7. Fundamentals of Analytical Chemistry – by Douglas A. Skoog** **8. Quantitative Chemical Analysis – by Daniel C. Harris** **9. Quantitative Inorganic Analysis – by Arthur Israel Vogel** **10.Analytical Chemistry – by Gary D. Christian** **11. Instrumental Methods of Chemical Analysis**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Modern Approaches in Chemistry

PROGRAMME CODE : DSCC 3

COURSE CODE : SC2M26 DSCC: CHE-103(O)

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY(CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand emerging concepts and recent developments in different areas of chemistry.
  To learn advanced instrumental and analytical techniques used in modern research.
- To explore interdisciplinary applications in materials science, environmental, and biological chemistry.
- To develop skills in data analysis, interpretation, and scientific problem-solving.
- To enhance critical thinking and innovation in applying chemical knowledge.
- To apply modern chemical approaches to real-world and industrial challenges.

Course Outcomes

After successful completion of this course, students will be able to:

- * Understand and explain recent developments and emerging concepts in chemistry.
- * Apply advanced analytical and instrumental techniques in chemical analysis.
- * Integrate interdisciplinary knowledge in materials, environmental, and biological chemistry.
- * Analyze and interpret scientific data using modern methodologies.
- * Demonstrate critical thinking and problem-solving skills in complex chemical situations.
- * Apply innovative chemical approaches to research and real-world challenges.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**<u>Stecreochemistry</u>** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution optical purity, enantiotopic and diasterotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absensce of chiral carbon (biphenyls, allenes and spiranes) chirality due to helical shapes.	1	15

	Stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.		
Unit - II	<u>**Pericyclic Reactions**</u> Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Elecytrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systesms, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions, Sigmatropicrearrangements-suprafacial and antarafacial shifts of H, Sigmatropicshifs involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Copeand aza-Cope rearrangements. Fluxional tautomerism, Enereaction.	1	15
Unit - III	<u>**Chromatographic methods**</u>: General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equilibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.	1	15
Unit - IV	<u>**Solvent Extraction Separation**</u>: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency. SOLVENT EXTRACTION: Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction equilibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction	1	15
	REFERENCES **1. Stereochemistry of Organic Compounds: Principles and Applications – by D. Nasipuri** **2. Stereochemistry of Organic Compounds – by V. K. Ahluwalia** **3. Basic Stereochemistry of Organic Molecules – by Subrata Sengupta** **4. Stereochemistry of Organic Compounds – by**		

	Ernest L. Eliel and Samuel H. Wilen **5. Stereochemistry and Organic Reactions – by Dipak K. Mandal** **6. Organic Stereochemistry – by Michael J. T. Robinson** **7. Introduction to Stereochemistry – by Kurt Mislow** **8. Essentials of Pericyclic and Photochemical Reactions by Biswanath Dinda** **9. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach by Sunil Kumar, Vinod Kumar, and S. P. Singh** **10. Pericyclic Reactions & Organic Photochemistry by Vinay P. Sharma** **11. Pericyclic Reactions by Ian Fleming** **12. Pericyclic Reactions by G. B. Gill and M. R. Willis** **13. Advanced Organic Chemistry Part B: Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg** **14. Chromatography: Concepts and Contrasts Author: James M. Miller** **15. Chromatographic Methods Authors: A. Braithwaite & F.J. Smith** **16. Principles and Practice of Modern Chromatographic Methods Authors: Kevin Robards, Paul Haddad & Peter Jackson** **17.Chromatography Editor: Ivor Smith**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER- I

TYPE OF COURSE : PRACTICAL DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : PRACTICAL Discipline Specific Core Course: CHE104

PROGRAMME CODE : DSCC 4

COURSE CODE : SC2M26 PDSCC: CHE104(O)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Practical Discipline Specific Core Course (PDSCC 4)	4 Credit	25 CCE + 25 SEE =50	**SC2M26 PDSCC: CHE-104**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT CORE COURSE (PDSCC – 4)

1. **INORGANIC QUALITATIVE ANALYSIS HAVING SIX REDICALS** (MINIMUM EIGHT)
   (OUT OF SIX ONE MUST BE FROM RARE GROUP AND ONE MUST BE TRACE IN A MIXTURE)
   NEGATIVE REDICALS : Cl^-,Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1}$,PO_4^{-3},BO_3^{-3},CrO_4^{-2}
   POSSITIVE REDICALS : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   RARE : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   TRACE : Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1.}$

2. ORGANIC ISOLATION (ANY FOUR)

1. ISOLATION OF CURCUMIN FROM TURMERIC
2. ISOLATION OF EUGENOL FROM CINNAMON
3. ISOLATION ALOIN FROM ALOE
4. ISOLATION OF STARCH FROM POTATOES
5. ISOLATION OF PIPERINE FROM BLACK PAPER
6. ISOLATION OF CASIN FROM MILK

3. ORGANIC PREPARATION (ANY FOUR)

1. PHENYL ACETATE FROM PHENOL
2. RESACETOPHENON FROM RESORCINOL
3. DIAMINOBENZENE FROM ANILINE
4. SYM. TRI BROMO BENZENE FROM TRI BROMO ANILINE
5. META CHLORO NITRO BENZENE FROM META NITRO ANILINE
6. ETHYL CINNAMET FROM CINNAMIC ACID

4. PHYSICAL EXERCISE : (8 PRACTICALS)

(a) Chemical Kinetics

1. **Determine the effect of change in reactant concentration on the rate constant of hydrolysis of an ester/ionic reaction.**
2. **Determine the effect of change in temperature on the rate constant of hydrolysis of an ester/ionic reaction.**

(b) Instrumentationtal experiments

- **Cunductometry**

3. **Determine the normality and amount of (HCl + $H_2C_2O_4$) given solution by conductometric titration against 0.1 N sodium hydroxide.**
4. **Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurement and hence determine the energy of activation.**
5. **Analysis of aspirin (acetylsalicylic acid) by conductometric titration using 0.1 N NaOH / .1 N KOH**

- **Potentiometry**

6. **Determination of Halides-Determine the strength of halides in a mixture potentiometrically using 0.1 N AgNO3**
7. **To determine the instability constant of the silver-ammonia complex by potentiometry**

- **PH Metry**

8. **Determine the amount of aspirin (acetylsalicylic acid) in a tablet by pH-metric titration using 0.1 N NaOH / 0.1 N KOH**
9. **Determine the normality and amount of (HCl + $H_2C_2O_4$) a given solution by pH-metric titration against 0.1 N sodium hydroxide.**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER - I

TYPE OF COURSE : MULTI DISCIPLINE COURSE (THEORY)

COURSE NAME : **Industrial Chemistry based on Fibers and Dyes**
PROGRAMME CODE : **MDC 1**

COURSE CODE : **SC2M26 MDC:CHE-105(O)**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week: 02 Teaching Hours per Semester: 30	THEORY MULTI	External Marks (SEE) –25 Internal Marks (CCE) - 25

Course Objectives

* To understand the fundamentals of synthetic fibers and their properties.
* To study the chemistry, classification, and manufacturing of dyes.
* To learn dyeing techniques and interactions between dyes and fibers.
* To analyze industrial processes involved in fiber production and dye application.
* To understand environmental and safety aspects of dye and textile industries.
* To apply chemical knowledge to real-world textile and industrial applications.

Course Outcomes

* Classify natural and synthetic fibers and explain their properties.
* Describe the chemistry, types, and preparation of dyes.
* Explain dye–fiber interactions and various dyeing techniques.
* Analyze industrial processes used in fiber production and dye application.
* Evaluate environmental, safety, and pollution aspects of textile industries.
* Apply knowledge of fibers and dyes in practical and industrial contexts.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Industrial Chemistry based on synthetic fibers** Definition, Ttypes of fibers, polymers and polymerisation, some important synthetic fibers, polyester, acrylic nylon, rayon, advantages ,disadvantages and their environmental impact’	1	15
Unit – II	**Industrial Chemistry based on Dyes** Introduction , types of common dyes	1	15

	,characteristic of dyes, classification of dyes based on structure and application method.		

) **HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER - I

TYPE OF COURSE : PRACTICAL MULTI DISCIPLINE COURSE (Practical)

COURSE NAME : LABORATORY PRACTICAL COURSE

PROGRAMME CODE : MDC 2

COURSE CODE : SC2M26 PMDC: CHE-106(O)

(Effective from June 2026 under NEP-2020

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
MULTU Discipline Course (Practical) (PMDSC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE: (PMDC – Multi))

MULTIDISCIPLINE PRACTICAL **(TOTAL SIX : At least any two of each group)**

INORGANIC :

1. ALLOY analysis OF BRASS (Cu estimation by Sodium thiosulphate)
2. ALLOY analysis OF BRONZE (Cu estimation by Sodium thiosulphate)
3. ALLOY analysis OF GERMAN SILVER (Cu estimation by Sodium thiosulphate)

Organic :

4. ESTIMATION OF ASPIRIN in given sample
5. ESTIMATION OF ASCORBIC ACID in given sample
6. ESTIMATION OF PHENOL / ANILINE in given sample

Volumetric:

7. Amount determination Cu by EDTA volumetrically
8. Amount determination Zn by EDTA volumetrically
9. Amount determination Mg by EDTA volumetrically

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. ORGANIC CHEMISTRY: SEMESTER - I

TYPE OF COURSE : VALUE ADDED COURSE (T)
COURSE NAME : FOOD CHEMISTRY
PROGRAMME CODE : VAC

COURSE CODE : SC2M26 VAC: CHE-107(O)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
VALUE ADDED COURSE (T) :(VAC)	2	25 CCE + 25 SEE =50	**SC2M26 VAC: CHE-107(O)**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Introduction to food Chemistry** Definition and Scope of Food Chemistry Composition of Foood Classification of Food Component Cabohydrates in Food Proteins in Food LIPID & Fats in Food Vitamins and Minerals in Food	1	15
Unit – II	**Food Additives** Introduction and Classification of Food Additives Food colorants ,Flavouring agents ,Sweeteners, imulsifyers and stabilizer and anti oxidant and preservatives	1	15

Hem.North Gujarat Uni.,PATAN

PHARMACEUTICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY COURSE WORK PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HOUR S/ WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(PHA)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(PHA)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(PHA)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(PHA)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(PHA)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(PHA)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(PHA)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(PHA)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(PHA)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(PHA)	Inorganic and Organic Spectroscopy	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(PHA)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(PHA)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(PHA)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(PHA)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(PHA)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(PHA)	Spectroscopic Techniques for Quality Control	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(PHA)	Drugs in Pharmacology -1	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(PHA)	GMP and Quality Control	T	4	4	50	50
	DSCC4	SC2M26DSCCCHE304(PHA)	Pharma Chemistry Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(PHA)	Heterocyclic Chemistry	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE306(PHA)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(PHA)	Natural Products	T	2	2	25	25
IV	DSCC1	SC2M26DSCCCHE401(PHA)	Advanced Instrumental Techniques	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE402(PHA)	Drugs in Pharmacology –II	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(PHA)	New Chemical Entity for Clinical Research	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE404(PHA)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE405(PHA)	Dosage Form Design	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE406(PHA)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE407(PHA)	Pharmaceutical Jurisprudence	T	2	2	25	25

Hem.North Gujarat Uni.,PATAN

PHARMACEUTICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

COURSE WORK WITH RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HOUR S/ WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(PHA)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(PHA)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(PHA)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(PHA)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(PHA)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(PHA)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(PHA)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(PHA)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(PHA)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	**SC2M26 DSCC: CHE203(PHA)**	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	**SC2M26PDSCC: CHE204(PHA)**	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	**SC2M26MDC: CHE205(PHA)**	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	**SC2M26 (Online) DSC:CHE-206(PHA)**	**SWAYAM (Select from portal)**	T	**2**	**2**	**25**	**25**
	SEC	**SC2M26 SEC : CHE206(PHA)**	Industrial chemistry based on Drugs	T				
	VOC	**SC2M26 VOC: CHE207(PHA)**	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	DSCC1	**SC2M26DSCCCHE301(PHA)**	**Spectroscopic Techniques for Quality Control**	T	**4**	**4**	**50**	**50**
	DSCC2	**SC2M26DSCCCHE302(PHA)**	**Drugs in Pharmacology -1**	T	**4**	**4**	**50**	**50**
	DSCC3	**SC2M26DSCCCHE303(PHA)**	**GMP and Quality Control**	T	**4**	**4**	**50**	**50**
	DSCC4	**SC2M26DSCCCHE304(PHA)**	**Pharma Chemistry Practical**	T	**4**	**4**	**50**	**50**
	DSEC1	**SC2M26DSECCHE305(PHA)**	**Heterocyclic Chemistry**	T	**2**	**2**	**25**	**25**
	DSEC2	**SC2M26PDSECCHE306(PHA)**	**Practical**	T	**2**	**2**	**25**	**25**
	DSEC3	**SC2M26DSECCHE307(PHA)**	**Natural Products**	T	**2**	**2**	**25**	**25**
IV	**DSCC1**	**SC2MRPCHE401(PHA)**	**Research Project**	P	**16**	**16**	**200**	**200**
	DSCC2	**SC2MSCHE401(PHA)**	**Seminar**	P	**6**	**6**	**75**	**75**

Hem.North Gujarat Uni.,PATAN

PHARMACEUTICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HOUR S/ WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(PHA)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(PHA)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(PHA)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCPC: CHE104(PHA)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(PHA)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(PHA)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(PHA)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(PHA)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(PHA)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(PHA)	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	SC2M26PDSCC: CHE204(PHA)	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	SC2M26MDC: CHE205(PHA)	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	SC2M26 (Online) DSC:CHE-206(PHA)	**SWAYAM (Select from portal)**	T	**2**	**2**	**25**	**25**
	SEC	SC2M26 SEC : CHE206(PHA)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(PHA)	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	DSCC1	SC2MRPCHE301(PHA)	Research Project	P	22	22	275	275
IV	DSCC1	SC2MRPCHE401(PHA)	Research Project	P	22	22	275	275

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Core Concepts in Organic and Coordination Chemistry

PROGRAMME CODE : DSCC 1

COURSE CODE : SC2M26 DSCC: CHE-101(PHA)

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand the fundamental principles of bonding in organic and coordination compounds.
- To develop knowledge of structure, reactivity, and stability of metal–ligand complexes.
- To analyze organic reaction mechanisms and factors influencing chemical reactions.
- To interpret spectroscopic techniques such as NMR for structural determination.
- To build problem-solving skills related to synthesis and chemical behavior.
- To apply theoretical concepts to practical and industrial chemical processes.

Course Outcomes

After completing this course, students will be able to:

- .* Explain the fundamental concepts of bonding in organic and coordination compounds.
- * Describe the structure, stability, and properties of metal–ligand complexes.
- * Analyze and predict organic reaction mechanisms and their outcomes.
- * Apply concepts of coordination and organic chemistry to solve chemical problems.
- * Demonstrate understanding of synthesis and reactivity in practical and industrial contexts

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stereochemistry and Bonding in Main Group Compounds,**	1	15

	VSEPR, Walsh diagrams (tri-and penta- atomic molecules), dπ-p π bonds, Bent rules and energetic of hybridization, some simple reactions of covalently bonded molecules.		
Unit - II	**Metal-Ligand Equilibrium** Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelae effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	1	15
Unit - III	**Nature of Bonding in organic Molecules** Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, enrgy level of pi-molecular orbital, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	1	15
Unit - IV	**Reaction Mechanism: Structure and Reactivity** Types of mechanism, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control, Hammond's postulate, CurtinHammett principle. Pottential energy diagrams, transition states and intermediates, methods of determining mechanisms isotope effects. Hard and soft acids and bases. Generation , Structure, stability and reacitivity of carbocations, carbanions, free radicals, Benzyne, carbenses and nitrenes. Effect of structure of reacitivity resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.	1	15

	References: 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. 2. Inorganic Chemistry, J.E. Huhey, Harpes&Row.~ 3. Chemistry of the Elements, vN.N. Greenwood and A. Earnshow, Pergamon. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. 5. Inorganic Chemistry by S.F.A.Cotton 6. Comprehensive Coordination Chemistryeds., G. Wilkinson, FLD.GillarsandJ.A McCleverty, Pergamon. 7. Advanced Organic Chemistry-Reactions, Mechanism and Structure, JerryMarch, Johri Wiley. 8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum. 9. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman. 10. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press. 11. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall. 12. Modern Organic Reactions, H. O. House, Benjamin. 13. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan. 14. Stereochemistry of Organic Compounds, D. Nasipuri, New AgeInte		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Advanced Concepts in Analytical and Physical Chemistry** **PROGRAMME CODE** : **DSCC 2**

COURSE CODE : **SC2M26 DSCC: CHE-102 (PHA)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

* To develop a deeper understanding of advanced analytical techniques and their applications.
* To study principles of thermodynamics and statistical mechanics in chemical systems.
* To understand redox processes, titration methods, and precipitation equilibria.
* To analyze chemical data and interpret experimental results accurately.
* To enhance problem-solving skills in physical and analytical chemistry contexts.
* To apply theoretical concepts to real-life laboratory and industrial situations.

Course Outcomes

After completing this course, students will be able to:

- * Apply advanced analytical techniques for qualitative and quantitative chemical analysis.
- * Explain principles of thermodynamics and statistical mechanics in chemical systems.
- * Analyze redox processes, titrations, and precipitation equilibria effectively.
- * Interpret experimental data and draw accurate scientific conclusions.
- * Solve complex problems related to physical and analytical chemistry.
- * Relate theoretical concepts to laboratory practices and industrial applications.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Statistical Thermodynamics** Introduction Combination and permutation Probability Sterling approximate formula (No Derivation) Type of Statistics Maxwell-Boltzmann Bose-Einstine Statistics Fermi-Dirac Statistics Partition Function	1	15

	Transnational Partition function Rotational Partition function Vibrantional Partition function Numericals		
Unit – II	**<u>Macromelecules</u>** Classification of Polymers Tacticity of polymers. (Optical Isomers) Polymerization reaction with example - Addition Polymerization. (Polyethylene, Polystyrene,PVC) - Condensation Polymerization (Nylon-66, Dacron) Mechanisms of Polymerization Free radical chain Polymerization Anionic Polymerization Cationic Polymerization Kinctics of Free radical chain Polymerization Degree of Polymerization Molar masses of Polymer Number Average Molar Mass Weight Average Molar Mass Determination of Molar Masses of Macro Molecules Viscosity Method Light Scattering Method ,Numerical	1	15
Unit - III	**<u>Redox titration</u>:** Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors. Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants. Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of: (1) One electron system (2) Multi electron system, Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	1	15

Unit - IV	**<u>Theory of precipitation:</u>** Formation of precipitates, Particle size of precipitates, Impurities in precipitates, Purification of precipitates, Precipitation from homogeneous solution, Precipitation titrimetry, Mohr's method, Volhard method , Fajan method, construction of titration curve, Factors influencing the sharpness of end point	1	15
	Reference Books **1.Introduction to Modern Statistical Mechanics – by David Chandler** **2. Statistical Thermodynamics** **3. Thermodynamics and Statistical Thermodynamics** **4. Textbook of Polymer Science – by Fred W. Billmeyer Jr.** **5. Polymer Chemistry** **Principles of Polymerization – by George Odian** **6. Vogel's Textbook of Quantitative Chemical Analysis** **7. Fundamentals of Analytical Chemistry – by Douglas A. Skoog** **8. Quantitative Chemical Analysis – by Daniel C. Harris** **9. Quantitative Inorganic Analysis – by Arthur Israel Vogel** **10.Analytical Chemistry – by Gary D. Christian** **11. Instrumental Methods of Chemical Analysis**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : Modern Approaches in Chemistry
PROGRAMME CODE : DSCC 3

COURSE CODE : SC2M26 DSCC: CHE-103(PHA)

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY(CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand emerging concepts and recent developments in different areas of chemistry.
  To learn advanced instrumental and analytical techniques used in modern research.
- To explore interdisciplinary applications in materials science, environmental, and biological chemistry.
- To develop skills in data analysis, interpretation, and scientific problem-solving.
- To enhance critical thinking and innovation in applying chemical knowledge.
- To apply modern chemical approaches to real-world and industrial challenges.

Course Outcomes

After successful completion of this course, students will be able to:

- * Understand and explain recent developments and emerging concepts in chemistry.
- * Apply advanced analytical and instrumental techniques in chemical analysis.
- * Integrate interdisciplinary knowledge in materials, environmental, and biological chemistry.
- * Analyze and interpret scientific data using modern methodologies.
- * Demonstrate critical thinking and problem-solving skills in complex chemical situations.
- * Apply innovative chemical approaches to research and real-world challenges.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	<u>**Stecreochemistry**</u> Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution optical purity, enantiotopic and diasterotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical	1	15

	activity in the absensce of chiral carbon (biphenyls, allenes and spiranes) chirality due to helical shapes. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.		
Unit - II	**<u>Pericyclic Reactions</u>** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Elecytrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systesms, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions, Sigmatropicrearrangements-suprafacial and antarafacial shifts of H, Sigmatropicshifs involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Copeand aza-Cope rearrangements. Fluxional tautomerism, Enereaction.	1	15
Unit - III	**<u>Chromatographic methods</u>**: General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equilibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.	1	15
Unit - IV	**<u>Solvent Extraction Separation</u>**: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency. SOLVENT EXTRACTION: Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction equilibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction	1	15
	REFERENCES **1. Stereochemistry of Organic Compounds: Principles and Applications – by D. Nasipuri**		

	2. Stereochemistry of Organic Compounds – by V. K. Ahluwalia 3. Basic Stereochemistry of Organic Molecules – by Subrata Sengupta 4. Stereochemistry of Organic Compounds – by Ernest L. Eliel and Samuel H. Wilen 5. Stereochemistry and Organic Reactions – by Dipak K. Mandal 6. Organic Stereochemistry – by Michael J. T. Robinson 7. Introduction to Stereochemistry – by Kurt Mislow 8. Essentials of Pericyclic and Photochemical Reactions by Biswanath Dinda 9. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach by Sunil Kumar, Vinod Kumar, and S. P. Singh 10. Pericyclic Reactions & Organic Photochemistry by Vinay P. Sharma 11. Pericyclic Reactions by Ian Fleming 12. Pericyclic Reactions by G. B. Gill and M. R. Willis 13. Advanced Organic Chemistry Part B: Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg 14. Chromatography: Concepts and Contrasts Author: James M. Miller 15. Chromatographic Methods Authors: A. Braithwaite & F.J. Smith 16. Principles and Practice of Modern Chromatographic Methods Authors: Kevin Robards, Paul Haddad & Peter Jackson 17.Chromatography Editor: Ivor Smith		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : PRACTICAL DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : PRACTICAL Discipline Specific Core Course: CHE104

PROGRAMME CODE : DSCC 4

COURSE CODE : SC2M26 PDSCC: CHE104(PHA)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Practical Discipline Specific Core Course (PDSCC 4)	4 Credit	25 CCE + 25 SEE =50	**SC2M26 PDSCC: CHE-104**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT CORE COURSE (PDSCC – 4)

1. **INORGANIC QUALITATIVE ANALYSIS HAVING SIX REDICALS** (MINIMUM EIGHT)
   (OUT OF SIX ONE MUST BE FROM RARE GROUP AND ONE MUST BE TRACE IN A MIXTURE)
   NEGATIVE REDICALS : Cl^-,Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1}$,PO_4^{-3},BO_3^{-3},CrO_4^{-2}
   POSSITIVE REDICALS : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   RARE : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   TRACE : Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1}$.

2. ORGANIC ISOLATION (ANY FOUR)

1. ISOLATION OF CURCUMIN FROM TURMERIC
2. ISOLATION OF EUGENOL FROM CINNAMON
3. ISOLATION ALOIN FROM ALOE
4. ISOLATION OF STARCH FROM POTATOES
5. ISOLATION OF PIPERINE FROM BLACK PAPER
6. ISOLATION OF CASIN FROM MILK

3. ORGANIC PREPARATION (ANY FOUR)

1. PHENYL ACETATE FROM PHENOL
2. RESACETOPHENON FROM RESORCINOL
3. DIAMINOBENZENE FROM ANILINE
4. SYM. TRI BROMO BENZENE FROM TRI BROMO ANILINE
5. META CHLORO NITRO BENZENE FROM META NITRO ANILINE

6. ETHYL CINNAMET FROM CINNAMIC ACID

4. PHYSICAL EXERCISE : (8 PRACTICALS)

(a) Chemical Kinetics

1. **Determine the effect of change in reactant concentration on the rate constant of hydrolysis of an ester/ionic reaction.**
2. **Determine the effect of change in temperature on the rate constant of hydrolysis of an ester/ionic reaction.**

(b) Instrumentationtal experiments

- **<u>Cunductometry</u>**

3. **Determine the normality and amount of ($HCl + H_2C_2O_4$) given solution by conductometric titration against 0.1 N sodium hydroxide.**
4. **Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurement and hence determine the energy of activation.**
5. **Analysis of aspirin (acetylsalicylic acid) by conductometric titration using 0.1 N NaOH / .1 N KOH**

- **<u>Potentiometry</u>**

6. **Determination of Halides-Determine the strength of halides in a mixture potentiometrically using 0.1 N AgNO3**
7. **To determine the instability constant of the silver-ammonia complex by potentiometry**

- **<u>PH Metry</u>**

8. **Determine the amount of aspirin (acetylsalicylic acid) in a tablet by pH-metric titration using 0.1 N NaOH / 0.1 N KOH**
9. **Determine the normality and amount of ($HCl + H_2C_2O_4$) a given solution by pH-metric titration against 0.1 N sodium hydroxide.**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL L CHEMISTRY: SEMESTER - I

TYPE OF COURSE : MULTI DISCIPLINE COURSE (THEORY)

COURSE NAME : **Industrial Chemistry based on Fibers and Dyes**
PROGRAMME CODE : **MDC 1**

COURSE CODE : **SC2M26 MDC:CHE-105(PHA)**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week: 02 Teaching Hours per Semester: 30	THEORY MULTI	External Marks (SEE) –25 Internal Marks (CCE) - 25

Course Objectives

* To understand the fundamentals of synthetic fibers and their properties.
* To study the chemistry, classification, and manufacturing of dyes.
* To learn dyeing techniques and interactions between dyes and fibers.
* To analyze industrial processes involved in fiber production and dye application.
* To understand environmental and safety aspects of dye and textile industries.
* To apply chemical knowledge to real-world textile and industrial applications.

Course Outcomes

* Classify natural and synthetic fibers and explain their properties.
* Describe the chemistry, types, and preparation of dyes.
* Explain dye–fiber interactions and various dyeing techniques.
* Analyze industrial processes used in fiber production and dye application.
* Evaluate environmental, safety, and pollution aspects of textile industries.
* Apply knowledge of fibers and dyes in practical and industrial contexts.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Industrial Chemistry based on synthetic fibers** Definition, Ttypes of fibers, polymers and polymerisation, some important synthetic fibers, polyester, acrylic nylon, rayon, advantages ,disadvantages and their environmental impact’	1	15
Unit – II	**Industrial Chemistry based on Dyes** Introduction , types of common dyes	1	15

	,characteristic of dyes, classification of dyes based on structure and application method.		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : PRACTICAL MULTI DISCIPLINE COURSE (Practical)

COURSE NAME : LABORATORY PRACTICAL COURSE

PROGRAMME CODE : MDC 2

COURSE CODE : SC2M26 PMDC: CHE-106(PHA)

(Effective from June 2026 under NEP-2020

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
MULTU Discipline Course (Practical) (PMDSC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-106(PHA)**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE: (PMDC – Multi))

MULTIDISCIPLINE PRACTICAL **(TOTAL SIX : At least any two of each group)**

INORGANIC :

1. ALLOY analysis OF BRASS (Cu estimation by Sodium thiosulphate)
2. ALLOY analysis OF BRONZE (Cu estimation by Sodium thiosulphate)
3. ALLOY analysis OF GERMAN SILVER (Cu estimation by Sodium thiosulphate)

Organic :

4. ESTIMATION OF ASPIRIN in given sample
5. ESTIMATION OF ASCORBIC ACID in given sample
6. ESTIMATION OF PHENOL / ANILINE in given sample

Volumetric:

7. Amount determination Cu by EDTA volumetrically
8. Amount determination Zn by EDTA volumetrically
9. Amount determination Mg by EDTA volumetrically

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHARMACEUTICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : VALUE ADDED COURSE (T)
COURSE NAME : FOOD CHEMISTRY
PROGRAMME CODE : VAC

COURSE CODE : SC2M26 VAC: CHE-107(PHA)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
VALUE ADDED COURSE (T) :(VAC)	2	25 CCE + 25 SEE =50	**SC2M26 VAC: CHE-107(PHA)**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Introduction to food Chemistry** Definition and Scope of Food Chemistry Composition of Foood Classification of Food Component Cabohydrates in Food Proteins in Food LIPID & Fats in Food Vitamins and Minerals in Food	1	15
Unit – II	**Food Additives** Introduction and Classification of Food Additives Food colorants ,Flavouring agents ,Sweeteners, imulsifyers and stabilizer and anti oxidant and preservatives	1	15

Hem.North Gujarat Uni.,PATAN

PHYSICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY COURSE WORK PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERNAL MARKS
I	DSCC1	SC2M26 DSCC: CHE101(P)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(P)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(P)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(P)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(P)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(P)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(P)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(P)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(P)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(P)	Inorganic and Organic Spectroscopy	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(P)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26MDC: CHE205(P)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(P)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(P)	Industrial chemistry based on Drugs	T				
	VOC	SC2M26 VOC: CHE207(P)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(P)	Modern Physical Chemistry	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(P)	Concept of Electro Chemistry	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(P)	Modern Approach of Polymer Chemistry-1	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE304(P)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(P)	Modern Instrumental techniques in physical chemistry	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE306(P)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(P)	Nano Science and Green Chemistry	T	2	2	25	25
IV	DSCC1	SC2M26DSCCCHE401(P)	Physical Chemistry of light, matter and reaction rate	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE402(P)	Physical Chemistry of Solution and Ionic Liquid	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE403(P)	Modern Approaches of Polymer Chemistry-2	T	4	4	50	50
	DSCC4	SC2M26PDSCCCHE404(P)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE405(P)	Advance Nuclear Chemistry	T	2	2	25	25

	DSEC2	**SC2M26PDSECCHE406(P)**	**Practical**	T	**2**	**2**	**25**	**25**
	DSEC3	**SC2M26DSECCHE407(P)**	**Chromatography**	T	**2**	**2**	**25**	**25**

Hem.North Gujarat Uni.,PATAN

PHYSICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

COURSE WORK WITH RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(P)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(P)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(P)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE104(P)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(P)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(P)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(P)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(P)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(P)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	SC2M26 DSCC: CHE203(P)	Inorganic and Organic Spectroscopy	T	4	4	50	50
	DSCC4	SC2M26PDSCC: CHE204(P)	PRACTICAL	P	4	4	50	50
	MDC	SC2M26M DC: CHE205(P)	Chemistry of Catalysis	T	2	2	25	25
	SWAYAM	SC2M26 (Online) DSC:CHE-206(P)	SWAYAM (Select from portal)	T	2	2	25	25
	SEC	SC2M26 SEC : CHE206(P)	Industrial chemistry based on Drugs	T	2	2	25	25
	VOC	SC2M26 VOC: CHE207(P)	Waste management and recycling of chemical	T	2	2	25	25
III	DSCC1	SC2M26DSCCCHE301(P)	Modern Physical Chemistry	T	4	4	50	50
	DSCC2	SC2M26DSCCCHE302(P)	Concept of Electro Chemistry	T	4	4	50	50
	DSCC3	SC2M26DSCCCHE303(P)	Modern Approach of Polymer Chemistry-1	T	4	4	50	50
	DSCC4	SC2M26DSCCCHE304(P)	Practical	T	4	4	50	50
	DSEC1	SC2M26DSECCHE305(P)	Modern Instrumental techniques in physical chemistry	T	2	2	25	25
	DSEC2	SC2M26PDSECCHE306(P)	Practical	T	2	2	25	25
	DSEC3	SC2M26DSECCHE307(P)	Nano Science and Green Chemistry	T	2	2	25	25
IV	DSCC1	SC2MRPCHE401(P)	Research Project	P	16	16	200	200
	DSCC2	SC2MSCHE401(P)	Seminar	P	6	6	75	75

Hem.North Gujarat Uni.,PATAN

PHYSICAL CHEMISTRY

TWO-YEAR POST GRADUATE (P.G) PROGRAMME

ONLY RESEARCH PROGRAMME

SEMESTER	COURS E TYPE	COURSE CODE	COURSE TITLE	THEORY/ PRACTIC AL	HO UR S / WE EK	CRED IT	INTE RNAL MAR KS	EXTERN A L MARKS
I	DSCC1	SC2M26 DSCC: CHE101(P)	Core Concepts in Organic and Coordination Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE102(P)	Advanced Concepts in Analytical and Physical Chemistry	T	4	4	50	50
	DSCC3	SC2M26 DSCC: CHE103(P)	Modern Approaches in Chemistry	T	4	4	50	50
	DSCC4	SC2M26PDSCPC: CHE104(P)	Practical	T	4	4	50	50
	MDC1	SC2M26 MDC:CHE105(P)	Industrial Chemistry based on Fibers and Dyes	T	2	2	25	25
	MDC2	SC2M26 PMDC: CHE-106(P)	Practical	P	2	2	25	25
	VAC	SC2M26 VAC: CHE107(P)	FOOD CHEMISTRY :	T	2	2	25	25
II	DSCC1	SC2M26 DSCC: CHE201(P)	Structure , Bonding and Spectroscopic Studies in Organic and Organo Metallic Chemistry	T	4	4	50	50
	DSCC2	SC2M26 DSCC: CHE202(P)	Advanced Physical Chemistry	T	4	4	50	50

	DSCC3	**SC2M26 DSCC: CHE203(P)**	**Inorganic and Organic Spectroscopy**	T	**4**	**4**	**50**	**50**
	DSCC4	**SC2M26PDSCC: CHE204(P)**	**PRACTICAL**	P	**4**	**4**	**50**	**50**
	MDC	**SC2M26M DC: CHE205(P)**	**Chemistry of Catalysis**	T	**2**	**2**	**25**	**25**
	SWAYAM	**SC2M26 (Online) DSC:CHE-206(P)**	**SWAYAM (Select from portal)**	T	**2**	**2**	**25**	**25**
	SEC	**SC2M26 SEC : CHE206(P)**	Industrial chemistry based on Drugs	T				
	VOC	**SC2M26 VOC: CHE207(P)**	Waste management and recycling of chemical	T	**2**	**2**	**25**	**25**
III	**DSCC1**	**SC2MRPCHE301(P)**	Research Project	P	22	22	275	275
IV	**DSCC1**	**SC2MRPCHE401(P)**	Research Project	P	22	22	275	275

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Core Concepts in Organic and Coordination Chemistry**

PROGRAMME CODE : **DSCC 1**

COURSE CODE : **SC2M26 DSCC: CHE-101(P)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand the fundamental principles of bonding in organic and coordination compounds.
- To develop knowledge of structure, reactivity, and stability of metal–ligand complexes.
- To analyze organic reaction mechanisms and factors influencing chemical reactions.
- To interpret spectroscopic techniques such as NMR for structural determination.
- To build problem-solving skills related to synthesis and chemical behavior.
- To apply theoretical concepts to practical and industrial chemical processes.

Course Outcomes

After completing this course, students will be able to:

- .* Explain the fundamental concepts of bonding in organic and coordination compounds.
- * Describe the structure, stability, and properties of metal–ligand complexes.
- * Analyze and predict organic reaction mechanisms and their outcomes.
- * Apply concepts of coordination and organic chemistry to solve chemical problems.
- * Demonstrate understanding of synthesis and reactivity in practical and industrial contexts

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stereochemistry and Bonding in Main Group Compounds**, VSEPR, Walsh diagrams (tri-and penta- atomic molecules), dπ-p π bonds, Bent rules and energetic of hybridization, some simple reactions of covalently bonded molecules.	1	15
Unit - II	**Metal-Ligand Equilibrium** Solution Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and Ligand, chelae effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	1	15
Unit - III	**Nature of Bonding in organic Molecules** Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, enrgy level of pi-molecular orbital, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	1	15

Unit - IV	**Reaction Mechanism: Structure and Reactivity** Types of mechanism, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control, Hammond’s postulate, CurtinHammett principle. Pottential energy diagrams, transition states and intermediates, methods of determining mechanisms isotope effects. Hard and soft acids and bases. Generation , Structure, stability and reacitivity of carbocations, carbanions, free radicals, Benzyne, carbenses and nitrenes. Effect of structure of reacitivity resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.	1	15
	References: 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. 2. Inorganic Chemistry, J.E. Huhey, Harpes&Row.~ 3. Chemistry of the Elements, vN.N. Greenwood and A. Earnshow, Pergamon. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. 5. Inorganic Chemistry by S.F.A.Cotton 6. Comprehensive Coordination Chemistryeds., G. Wilkinson, FLD.GillarsandJ.A McCleverty, Pergamon. 7. Advanced Organic Chemistry-Reactions, Mechanism and Structure, JerryMarch, Johri Wiley. 8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum. 9. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman. 10. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.		

	11. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall. 12. Modern Organic Reactions, H. O. House, Benjamin. 13. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan. 14. Stereochemistry of Organic Compounds, D. Nasipuri, New AgeInte		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Advanced Concepts in Analytical and Physical Chemistry**

PROGRAMME CODE : **DSCC 2**

COURSE CODE : **SC2M26 DSCC: CHE-102 (P)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY (CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

* To develop a deeper understanding of advanced analytical techniques and their applications.
* To study principles of thermodynamics and statistical mechanics in chemical systems.
* To understand redox processes, titration methods, and precipitation equilibria.
* To analyze chemical data and interpret experimental results accurately.
* To enhance problem-solving skills in physical and analytical chemistry contexts.
* To apply theoretical concepts to real-life laboratory and industrial situations.

Course Outcomes

After completing this course, students will be able to:

- * Apply advanced analytical techniques for qualitative and quantitative chemical analysis.
- * Explain principles of thermodynamics and statistical mechanics in chemical systems.
- * Analyze redox processes, titrations, and precipitation equilibria effectively.
- * Interpret experimental data and draw accurate scientific conclusions.
- * Solve complex problems related to physical and analytical chemistry.
- * Relate theoretical concepts to laboratory practices and industrial applications.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Statistical Thermodynamics** Introduction Combination and permutation Probability Sterling approximate formula (No Derivation)	1	15

	Type of Statistics Maxwell-Boltzmann Bose-Einstine Statistics Fermi-Dirac Statistics Partition Function Transnational Partition function Rotational Partition function Vibrantional Partition function Numericals		
Unit – II	**<u>Macromelecules</u>** Classification of Polymers Tacticity of polymers. (Optical Isomers) Polymerization reaction with example - Addition Polymerization. (Polyethylene, Polystyrene,PVC) - Condensation Polymerization (Nylon-66, Dacron) Mechanisms of Polymerization Free radical chain Polymerization Anionic Polymerization Cationic Polymerization Kinctics of Free radical chain Polymerization Degree of Polymerization Molar masses of Polymer Number Average Molar Mass Weight Average Molar Mass Determination of Molar Masses of Macro Molecules Viscosity Method Light Scattering Method ,Numerical	1	15
Unit - III	**<u>Redox titration</u>:** Titration involving Iodine: iodimetry and iodometry, Titration with reducing agents and oxidising agents, metallic reductors. Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron(II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators. Numericals: Calculation based on emf of electrode/cell, end point calculations, equation constants. Introduction, Construction of the titration curves and calculation of Esystem in aqueous medium in case of: (1) One electron system (2) Multi electron system, Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	1	15

Unit - IV	**<u>Theory of precipitation:</u>** Formation of precipitates, Particle size of precipitates, Impurities in precipitates, Purification of precipitates, Precipitation from homogeneous solution, Precipitation titrimetry, Mohr's method, Volhard method , Fajan method, construction of titration curve, Factors influencing the sharpness of end point	1	15
	Reference Books **1.Introduction to Modern Statistical Mechanics – by David Chandler** **2. Statistical Thermodynamics** **3. Thermodynamics and Statistical Thermodynamics** **4. Textbook of Polymer Science – by Fred W. Billmeyer Jr.** **5. Polymer Chemistry** **Principles of Polymerization – by George Odian** **6. Vogel's Textbook of Quantitative Chemical Analysis** **7. Fundamentals of Analytical Chemistry – by Douglas A. Skoog** **8. Quantitative Chemical Analysis – by Daniel C. Harris** **9. Quantitative Inorganic Analysis – by Arthur Israel Vogel** **10.Analytical Chemistry – by Gary D. Christian** **11. Instrumental Methods of Chemical Analysis**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : **Modern Approaches in Chemistry**

PROGRAMME CODE : DSCC 3

COURSE CODE : **SC2M26 DSCC: CHE-103(P)**

(Effective from June 2026 under NEP-2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY(CORE)	External Marks (SEE) - 50 Internal Marks (CCE) - 50

Course Objectives

- To understand emerging concepts and recent developments in different areas of chemistry.
  To learn advanced instrumental and analytical techniques used in modern research.
- To explore interdisciplinary applications in materials science, environmental, and biological chemistry.
- To develop skills in data analysis, interpretation, and scientific problem-solving.
- To enhance critical thinking and innovation in applying chemical knowledge.
- To apply modern chemical approaches to real-world and industrial challenges.

Course Outcomes

After successful completion of this course, students will be able to:

- * Understand and explain recent developments and emerging concepts in chemistry.
- * Apply advanced analytical and instrumental techniques in chemical analysis.
- * Integrate interdisciplinary knowledge in materials, environmental, and biological chemistry.
- * Analyze and interpret scientific data using modern methodologies.
- * Demonstrate critical thinking and problem-solving skills in complex chemical situations.
- * Apply innovative chemical approaches to research and real-world challenges.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	**Stecreochemistry** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.	1	15

	Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution optical purity, enantiotopic and diasterotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absensce of chiral carbon (biphenyls, allenes and spiranes) chirality due to helical shapes. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.		
Unit - II	**<u>Pericyclic Reactions</u>** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Elecytrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systesms, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions, Sigmatropicrearrangements-suprafacial and antarafacial shifts of H, Sigmatropicshifs involving carbon moieties, 3,3 and 5,5-Sigmatropic rearrangements. Claisen, Copeand aza-Cope rearrangements. Fluxional tautomerism, Enereaction.	1	15
Unit - III	**<u>Chromatographic methods</u>**: General principle, classification of chromatographic separation. Ion exchange chromatography (Ion Exchange equilibria, Types of Ion Exchange capacity, Application of Ion Exchange resins). Gas Chromatography, Instrumentation and evolution of data. High Performance Liquid Chromatography (HPLC) Principle and Instrumentation.	1	15
Unit - IV	**<u>Solvent Extraction Separation</u>**: Principles of solvent extraction, choice of solvent, distribution coefficient, distribution ratio, percentage (%) extraction. The extraction process, solvent extraction of metals, selective extraction and separation efficiency. SOLVENT EXTRACTION: Distribution law, Determination of distribution ratio Batch extraction, continuous extraction, discontinuous extraction, counter current extraction SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction,	1	15

	Quantitative treatment of solvent Extraction equilibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction		
	REFERENCES **1. Stereochemistry of Organic Compounds: Principles and Applications – by D. Nasipuri** **2. Stereochemistry of Organic Compounds – by V. K. Ahluwalia** **3. Basic Stereochemistry of Organic Molecules – by Subrata Sengupta** **4. Stereochemistry of Organic Compounds – by Ernest L. Eliel and Samuel H. Wilen** **5. Stereochemistry and Organic Reactions – by Dipak K. Mandal** **6. Organic Stereochemistry – by Michael J. T. Robinson** **7. Introduction to Stereochemistry – by Kurt Mislow** **8. Essentials of Pericyclic and Photochemical Reactions by Biswanath Dinda** **9. Pericyclic Reactions: A Mechanistic and Problem-Solving Approach by Sunil Kumar, Vinod Kumar, and S. P. Singh** **10. Pericyclic Reactions & Organic Photochemistry by Vinay P. Sharma** **11. Pericyclic Reactions by Ian Fleming** **12. Pericyclic Reactions by G. B. Gill and M. R. Willis** **13. Advanced Organic Chemistry Part B: Reaction and Synthesis by Francis A. Carey and Richard J. Sundberg** **14. Chromatography: Concepts and Contrasts Author: James M. Miller** **15. Chromatographic Methods Authors: A. Braithwaite & F.J. Smith** **16. Principles and Practice of Modern Chromatographic Methods Authors: Kevin Robards, Paul Haddad & Peter Jackson** **17.Chromatography Editor: Ivor Smith**		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER- I

TYPE OF COURSE : PRACTICAL DISCIPLINE SPECIFIC CORE COURSE (THEORY)

COURSE NAME : PRACTICAL Discipline Specific Core Course: CHE104

PROGRAMME CODE : DSCC 4

COURSE CODE : SC2M26 PDSCC: CHE104(P)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Practical Discipline Specific Core Course (PDSCC 4)	4 Credit	25 CCE + 25 SEE =50	**SC2M26 PDSCC: CHE-104**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT CORE COURSE (PDSCC – 4)

1. **INORGANIC QUALITATIVE ANALYSIS HAVING SIX REDICALS** (MINIMUM EIGHT)
   (OUT OF SIX ONE MUST BE FROM RARE GROUP AND ONE MUST BE TRACE IN A MIXTURE)
   NEGATIVE REDICALS : Cl^-,Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1}$,PO_4^{-3},BO_3^{-3},CrO_4^{-2}
   POSSITIVE REDICALS : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   RARE : FROM 1^{ST} AND 2^{ND} GROUP AND V^{TH}-B
   TRACE : Br^-,I^-,CO_3^{-2},NO_3^{-1},$N0_2^{-1.}$

2. ORGANIC ISOLATION (ANY FOUR)

1. ISOLATION OF CURCUMIN FROM TURMERIC
2. ISOLATION OF EUGENOL FROM CINNAMON
3. ISOLATION ALOIN FROM ALOE
4. ISOLATION OF STARCH FROM POTATOES
5. ISOLATION OF PIPERINE FROM BLACK PAPER
6. ISOLATION OF CASIN FROM MILK

3. ORGANIC PREPARATION (ANY FOUR)

1. PHENYL ACETATE FROM PHENOL
2. RESACETOPHENON FROM RESORCINOL
3. DIAMINOBENZENE FROM ANILINE

4. SYM. TRI BROMO BENZENE FROM TRI BROMO ANILINE
5. META CHLORO NITRO BENZENE FROM META NITRO ANILINE
6. ETHYL CINNAMET FROM CINNAMIC ACID

4. PHYSICAL EXERCISE : (8 PRACTICALS)

(a) Chemical Kinetics

1. Determine the effect of change in reactant concentration on the rate constant of hydrolysis of an ester/ionic reaction.

2. Determine the effect of change in temperature on the rate constant of hydrolysis of an ester/ionic reaction.

(b) Instrumentational experiments

- **Cunductometry**

3. Determine the normality and amount of ($HCl + H_2C_2O_4$) given solution by conductometric titration against 0.1 N sodium hydroxide.

4. Study the kinetics of saponification of ethyl acetate by sodium hydroxide at two temperatures by conductance measurement and hence determine the energy of activation.

5. Analysis of aspirin (acetylsalicylic acid) by conductometric titration using 0.1 N NaOH / .1 N KOH

- **Potentiometry**

6. Determination of Halides-Determine the strength of halides in a mixture potentiometrically using 0.1 N AgNO3

7. To determine the instability constant of the silver-ammonia complex by potentiometry

- **PH Metry**

8. Determine the amount of aspirin (acetylsalicylic acid) in a tablet by pH-metric titration using 0.1 N NaOH / 0.1 N KOH

9. Determine the normality and amount of ($HCl + H_2C_2O_4$) a given solution by pH-metric titration against 0.1 N sodium hydroxide.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : MULTI DISCIPLINE COURSE (THEORY)

COURSE NAME : **Industrial Chemistry based on Fibers and Dyes**
PROGRAMME CODE : **MDC 1**

COURSE CODE : **SC2M26 MDC:CHE-105(P)**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week: 02 Teaching Hours per Semester: 30	THEORY MULTI	External Marks (SEE) –25 Internal Marks (CCE) - 25

Course Objectives

* To understand the fundamentals of synthetic fibers and their properties.
* To study the chemistry, classification, and manufacturing of dyes.
* To learn dyeing techniques and interactions between dyes and fibers.
* To analyze industrial processes involved in fiber production and dye application.
* To understand environmental and safety aspects of dye and textile industries.
* To apply chemical knowledge to real-world textile and industrial applications.

Course Outcomes

* Classify natural and synthetic fibers and explain their properties.

* Describe the chemistry, types, and preparation of dyes.

* Explain dye–fiber interactions and various dyeing techniques.

* Analyze industrial processes used in fiber production and dye application.

* Evaluate environmental, safety, and pollution aspects of textile industries.

* Apply knowledge of fibers and dyes in practical and industrial contexts.

Unit No.	Content	Credit	Lect. Hrs 60
Unit-I	<u>**Industrial Chemistry based on synthetic fibers**</u> Definition, Ttypes of fibers, polymers and polymerisation, some important synthetic fibers, polyester, acrylic nylon, rayon, advantages ,disadvantages and their environmental	1	15

	impact’		
Unit – II	**<u>Industrial Chemistry based on Dyes</u>** Introduction , types of common dyes ,characteristic of dyes, classification of dyes based on structure and application method.	1	15

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Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : PRACTICAL MULTI DISCIPLINE COURSE (Practical)

COURSE NAME : LABORATORY PRACTICAL COURSE
PROGRAMME CODE : MDC 2

COURSE CODE : SC2M26 PMDC: CHE-106(P)

(Effective from June 2026 under NEP-2020

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
MULTU Discipline Course (Practical) (PMDSC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE: (PMDC – Multi))

MULTIDISCIPLINE PRACTICAL **(TOTAL SIX : At least any two of each group)**

INORGANIC :

1. ALLOY analysis OF BRASS (Cu estimation by Sodium thiosulphate)
2. ALLOY analysis OF BRONZE (Cu estimation by Sodium thiosulphate)
3. ALLOY analysis OF GERMAN SILVER (Cu estimation by Sodium thiosulphate)

Organic :

4. ESTIMATION OF ASPIRIN in given sample
5. ESTIMATION OF ASCORBIC ACID in given sample
6. ESTIMATION OF PHENOL / ANILINE in given sample

Volumetric:

7. Amount determination Cu by EDTA volumetrically
8. Amount determination Zn by EDTA volumetrically
9. Amount determination Mg by EDTA volumetrically

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Two Year P. G Programme

M. Sc. PHYSICAL CHEMISTRY: SEMESTER - I

TYPE OF COURSE : VALUE ADDED COURSE (T)
COURSE NAME : FOOD CHEMISTRY
PROGRAMME CODE : VAC

COURSE CODE : SC2M26 VAC: CHE-107(P)

(Effective from June 2026 under NEP-2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
VALUE ADDED COURSE (T) :(VAC)	2	25 CCE + 25 SEE =50	**SC2M26 PMDC : CHE-105**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Introduction to food Chemistry** Definition and Scope of Food Chemistry Composition of Foood Classification of Food Component Cabohydrates in Food Proteins in Food LIPID & Fats in Food Vitamins and Minerals in Food	1	15
Unit – II	**Food Additives** Introduction and Classification of Food Additives Food colorants ,Flavouring agents ,Sweeteners, imulsifyers and stabilizer and anti oxidant and preservatives	1	15

Hemchandracharya North Gujarat University
PATAN - 384265

Faculty of Science

M.Sc. Physics Programme (2yearPG)
(Only Course Work Program) NEP 2020

With effect from June2026

Curriculum and Credit Frame work For M.Sc. SEM I To M.Sc. SEM IV

As per UGC Guidelines

(According to NATIONAL EDUCATION POLICY (NEP)–2020)

M.Sc. Physics Syllabus for Semester I TO IV

M.Sc. Physics (Course Work)

M.Sc. Physics (Only Course Work)

Hem.North Gujarat University,Patan
PHYSICS
TWO – YEAR PG
ONLY COURSE WORK PROGRAMME

SEM	COURSE TYPE	COURSE CODE	COURSE TITLE	THEORY / PRACTICAL	HOURS / WEEK	CREDIT	INTERNAL MARKS	EXTERNAL MARKS
I	DSCC1	SC2M26DSCCPHY101	MATHEMATICAL PHYSICS, QUANTUM, CLASSICALMECHANICS	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 102	SOLID STATE PHYSICS C-PROGRAMMING,ELECTRONICS-I AND DIGITAL ELECTRONICS	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 103	ELECTRODYNAMICS AND ELECTRONICS -II	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 104	PRACTICAL COURSE	P	4	4	50	50
	MDC1	SC2M26MDCPHY105	SPECTROSCOPY AND MICROSCOPY	T	2	2	25	25
	MDC2	SC2M26PMDCPHY106	PRACTICAL COURSE	P	2	2	25	25
	VAC	SC2M26VACPHY107	SCIENCE OF YOGA	T	2	2	25	25
II	DSCC1	SC2M26DSCCPHY201	MATHEMATICAL PHYSICS II, QUANTUM MECHANICS II, CLASSICAL MECHANICS II	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 202	SOLID STATE PHYSICS II, C-PROGRAMMING II, ELECTRONICS II	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 203	STATISTICAL MECHANICS AND MICROPROCESSOR PROGRAMME	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 204	PRACTICAL COURSE	P	4	4	50	50
	MDC	SC2M26MDCPHY205	NANO SCIENCE	T	2	2	25	25
	SEC	SC2M26PSECPHY206	PRACTICAL COURSE	P	2	2	25	25
	VOC	SC2M26VOCPHY207	PRAMANA SIDDHANTA : INDIAN METHODS OF INQUIRY	T	2	2	25	25

	SWAYAM	SWAYAM	SWAYAM- Select from Portal					
III	DSCC1	SC2M26DSCCPHY 301	NUCLEAR PHYSICS I, ELECTRODYNEMICS	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 302	STATISTICAL MECHANICS, QUANTUM MECHANICS	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 303	ATOMIC AND MOLECULAR SPECTROSCOPY SOLID STATE PHYSICS-3	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY304	PRACTICAL COURSE	P	4	4	50	50
	DSEC1	SC2M26DSECPHY305	PHYSICS OF THE UNIVERSE	T	2	2	25	25
	DSEC2	SC2M26PDSECPHY306	PRACTICAL COURSE	T	2	2	25	25
	DSEC3	SC2M26DSECPHY307	TRANSDUCERS and ELECTRICAL MACHINES	P	2	2	25	25
IV	DSCC1	SC2M26DSCCPHY401	NUCLEARPHYSICS-2ANDBIOPHYSICS	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 402	REMOTE SENSING	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 403	ELECTRONICS AND SOLID STATE PHYSICS-3	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 404	PROJECT	P	4	4	50	50
	DSEC1	SC2M26DSECPHY405	ENERGY TECHNOLOGY	T	2	2	25	25
	DSEC2	SC2M26DSECPHY406	COMPUTER SKILL WINDOWS and M S OFFICE	T	2	2	25	25
	DSEC3	SC2M26PDSECPHY407	PRACTICAL COURSE	P	2	2	25	25

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I 101

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: MATHEMATICAL PHYSICS, QUANTUM, CLASSICALMECHANICS

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY101**

(Effective from June 2026 under NEP- 2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
</table>

Course Objectives

- To develop a strong mathematical foundation in **complex variable theory** and its applications to physical problems.
- To understand **approximation methods in quantum mechanics**, including perturbation and variation techniques for stationary states.
- To introduce the principles of **classical mechanics** through canonical transformations, Poisson brackets, Hamilton–Jacobi theory, **Small Oscillation and Rotating Frame**.

Course Outcomes

After completing this course, students will be able to:

- Apply **complex analysis technique** such as contour integration, Laurent series, and residue theorem to evaluate definite integrals.
- Analyze **quantum mechanical systems** using perturbation theory and the variation method for both non-degenerate and degenerate cases.
- Use **canonical transformations, Poisson brackets, and action–angle variables** to solve problems in classical mechanics.
- Explain the **Small Oscillation in systems, Rotating Frame,** and **Euler angles**

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples. **Reference Books** M. L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, USA (2005). 2.P. K.Chattopadhyaya,MathematicalPhysics,3rdEd., New Age International Pvt. Ltd., New Delhi (2022).	1	15

	3. G.B.Arfken and H.J.Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier, USA (2005). 4. SatyaPrakash, Mathematical Physics,6thEd.,Sultan Chand & Sons, New Delhi (2020). 5. B.S.Rajput, Mathematical Physics,28thEd.,Pragati Prakashan, Meerut (2015).		
Unit -II	**Approximation Methods for Stationary States:** Perturbation theory for discrete levels, Equations in various orders of perturbation theory, Non-degenerate case, Degenerate case-removal of degeneracy, Effect of an electric field on the energy levels of an atom (Stark effect), Two – electron atoms. Illustrative examples. **The Variational Method:** Upper bound on ground state energy, Applications to excited states, Trial function linear in variational parameters, The Hydrogen molecule, Exchange interaction. Illustrative examples. **Reference Books** 1.P.M.Mathews and K.Venkatesan, A Text Book of Quantum Mechanics, 2nd Ed. TMH, New Delhi (2011). 2.V.K.Thankappan, QuantumMechanics,5thEd., New Age International Pub., New Delhi (2020). 3.G.Aruldhas,Quantum Mechanics,2ndEd.,PHI Learning Pvt. Ltd., Delhi (2017). 4.A.Ghatak and S.Loknathan, Quantum Mechanics, 6th Ed., Trinity Press, New Delhi (2019). 5.L.I.Schiff, Quantum Mechanics,4thEd.,Tata McGraw Hill Edu., New Delhi (2017). D.J.Griffiths and D.F.Schroeter, Introduction to Quantum Mechanics, 3rd Ed., Cambridge University Press India Pvt Ltd (2019).	1	15
Unit -III	**Canonical Transformation:** Canonical transformation and Hamilton Jacobi theory: Gauge transformation, Canonical transformation, condition for transformations to be Canonical. Poisson bracket, canonical equations in terms of Poisson bracket notation, Relation between infinitesimal transformation and Poisson brackets, The Hamilton Jacobi equations, Separation of variables, Action angle variables, Properties of action angle. **Reference Books** R.G.Takwale and P.S.Puranik, Introduction to Classical Mechanics, 55th Ed., TMH, New Delhi (2016). 2. H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics,3rdEd.,PearsonIndia,NewDelhi(2011). 3. V.B.Bhatia, Classical Mechanics Classical Mechanics: With Introduction to Nonlinear Oscillations and Chaos, Narosa Pub. House, New Delhi (2001). 4. J.C.Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016).	1	15

Unit-IV	**Small Oscillation and Rotating Frame:** Stable and unstable equilibriums, Small Oscillation in a system with one degree of freedom, Small Oscillation in a system with more than one degree of freedom, Normal coordinates and Normal frequencies of vibration. Rotating Frame, Euler angles, Inertia tensor, Euler's equations of motion of a rigid body, Free motion of a rigid body, Motion of a symmetric top. **Reference Books** 1.R. G. Takwale and P. S. Puranik, Introduction to ClassicalMechanics,55thEd.,TMH,NewDelhi(2016). 2.H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics, 3rd Ed., Pearson India, New Delhi (2011). 3.V. B. Bhatia, Classical Mechanics Classical Mechanics :With Introduction to Nonlinear Oscillations and Chaos, Narosa Pub. House, New Delhi (2001). 4.J. C. Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016). 5.G. Aruldhas, Classical Mechanics, 8th Ed., PHI Learning Private Limited, New Delhi (2017).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I 102

TYPE OFCOURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SOLID STATE PHYSICS, C-PROGRAMMING,

ELECTRONICS –I & DIGITAL ELECTRONICS

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY 102**

(Effective from June 2026 under NEP- 2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week: 04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks (SEE)- 50</td></tr>
<tr><td>Internal Marks (CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
To understand the electronic structure of solids, including energy and formation and Fermi surface concepts.
To introduce C programming fundamentals for problem-solving and scientific computation.
To study the working principles and applications of operational amplifiers in analog circuits.
To provide foundational knowledge of digital electronics, including flip-flops, registers, and counters.</td></tr>
<tr><td colspan="3">Course Outcomes
After completing this course, students will be able to:
Explain energy band theory, Bloch functions, and electron behavior in periodic potentials.
Write, execute, and debug basic C programs using appropriate data types and variables.
Analyze and design OP-AMP based circuits such as amplifiers, integrators, and waveform generators.
Understand and apply digital logic circuits including flip-flops, shift registers, and counters in practical systems.</td></tr>
</table>

Syllabus

Unit No.	**Content**	**Credit**	**Lect.Hrs 60**
Unit-I	**Energy Bands and Fermi Surfaces** **Energy Bands:** Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbital's in a band **Reference Books** 1.C.Kittle, Introduction to Solid State Physics, 8thEd., Wiley Eastern Limited, New Delhi (2018).	1	15

	2.J. P. Srivastava, Elements of Solid State Physics,4thEd.,PHIL earning Private Limited, Delhi (2016). 3.C.M.Kachhava, Solid State Physics, Solid State Devices and Electronics, New Age International Publishers, New Delhi (2011).		
Unit-II	**C-Programming** **(a) Overview of C**: History of C (1.1), Importance of C (1.2), Sample Program: Printinga Message(1.3),Basic Structure of C Programs (1.8), Programming Style (1.9), Executing a C Program (1.10). **(b) Constants, Variables & Data Types**: (**Programming in C)** Introduction(2.1),Character Set(2.2),C Tokens (2.3), Keywords and Identifiers (2.4), Constants (2.5), Variables (2.6), Data Types (2.7), Declaration of Variables (2.8), Declaration of Storage Class (2.9), Assigning Values of Variables (2.10), Defining Symbolic Constants (2.11), Declaring a Variable as Constant(2.12),Declaring a Variableas Volatile(2.13), Overflow and Underflow of Data (2.14). **Basic Reference:** *Programming in ANSIC by E.Balaguruswami (THM) (3rd Edition)*	1	15
Unit-III	**The Operational Amplifier & Applications** **OPERATIONAL AMPLIFIER**: Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing –Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator, **Reference Books** 1. K. R. Botkar, Integrated Circuits, 10th Ed., Khanna Publishers, New Delhi (1987). 2.R. Boylested and L. Nashelsky,ElectronicDevicesandCircuitTheory,4thEd., Longman Higher Education, New Delhi (1987). 3. J. D. Ryder, Electronic Fundamentals and Applications: Integrated and Discrete Systems,5thEd., PHI, New Delhi (1975). 4. A.Mottershead, Electronic Devices and Circuits: An Introduction PHI, New Delhi (1979). 5. K. V. Ramanan, Functional Electronics, Tata McGraw-Hill,NewDelhi(1984).6.R.Gayakwad,	1	15

	OP AMP & Linear Integrated Circuits, 3rdEd.,PHI, New Delhi (1993).		
Unit-IV	**DIGITALELECTRONICS** FLIPFLOP: RS FLIP-FLOPS, D FLIP-FLOPS, JK FLIP-FLOPS, and Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in serial out, serial in parallel out, parallel in serial out, parallel in parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. **Reference Books** A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications,8thEd.,TataMcGraw-Hill Publishing Company Limited, New Delhi (2014). 2. A.Kumar, Fundamentals of DigitalCircuits,4thEd., PHI Private Limited, New Delhi (2016). 3. M.Morris Mano, Digital Logic and Computer Design, PHI Private Limited, New Delhi (2006). 4. A.K.Maini, Digital Electronics Principles, Devices and Applications, 1st Ed., John Wiley & Sons Ltd, England (2007).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. PHYSICS: SEMESTER –I 103

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: ELECTRODYNAMICS AND ELECTRONICS -II

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY 103**

(Effective from June2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
To study the propagation of electromagnetic waves in matter, including reflection, transmission, and frequency-dependent material response.
To understand the principles and structures of waveguides and resonant cavities For guided wave propagation.
To introduce the operation, biasing, and frequency response of FETamplifiers, including JFETs and MOSFETs.
To analyze the working and performance of power amplifiers under different classes of operation.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
Analyze electromagnetic wave behavior in linear media, including normal and oblique incidence, total internal reflection, and metallic reflection.
Explain and apply concepts of waveguides, resonant cavities, and dielectric guides in microwave and communication systems.
Design and evaluate FET amplifier circuits (common source, common drain, and common gate) for low- and high-frequency applications.
Compare and analyze power amplifier classes (A, B, push-pull, tuned amplifiers) based on efficiency, power dissipation, and performance.</td></tr>
</table>

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Electromagnetic waves in Matter** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B. B., Electromagnetics, Wiley Eastern,(2nded.) 3. E.C.Jordanand K.G.Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15

Unit-II	**POYNTING VECTOR AND THE FLOW OF POWER:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conductor **WAVEGUIDES:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, waveguide of rectangular cross section, co-axial waveguides, resonant cavities, dielectric waveguides, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electro dynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B.B., Electromagnetics, Wiley Eastern, (2nded.) 3. E.C.Jordan and K.G.Balmain, Electromagnetic Waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15
Unit-III	**FETAmplifiers:** FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source a.c. amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source and common drain amplifier common source amplifier at high frequency, common drain amplifier at high frequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad, PHI Pub	1	15
Unit-IV	**Power Amplifier** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers, Class-A power amplifier, and power distribution, Transformer coupled class -A amplifier, Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26PDSCCPHY 104**

(Effective from June 2026 under NEP-2020)

<table>
<tr><th>TYPEOF COURSE</th><th>CREDIT</th><th>Marks</th><th>COURSECODE</th></tr>
<tr><td>Discipline Core Course Practical(PDSC)</td><td>2 (Group A) and 2 (Group B)(Total4 Credit)</td><td>25 CCE +25 SEE =50 (For Both Group)</td><td>SC2M26PDSCCPHY 104</td></tr>
<tr><td colspan="4">Teaching Hours
Teaching Hours per Week:08 Hours for 4 Credit practical (120 Hours per Semester)
Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)</td></tr>
</table>

LABORATORY EXPERIMENT COURSE:- GROUP A

(1) To find Hall co-efficient of Hall Effect
(2) To find Dead time of GM Counter
(3) To calculate self-inductance (L) of a given coil using Rayleigh Method
(4) Determination of velocity of Ultrasonic waves in a liquid/solid using Ultrasonic Interferometer
(5) To find wavelength of a monochromatic light using F P Interferometer
(6) Computer Simulation–I(Projectile Motion using MS EXCEL)
(7) Computer Simulation–II(Capacitor charging and discharging using MS EXCEL)
(8) Calculation of empty lattice energy bands(Theoretical)

LABORATORY EXPERIMENT COURSE:- GROUP B

(1) To find the frequency of Transistorized Phase shift Oscillator
(2) To find the frequency of Astable Multivibrator
(3) To obtain frequency response of FET Amplifier
(4) To find Bandwidth of OP-AMP as an Inverting OP-Amp
(5) To find LTP and UTP of Transistorized Schmitt Trigger
(6) To study characteristics of MOSFET
(7) To study characteristics of SCR
(8) Numerical solution of a polynomial(Theoretical)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. PHYSICS: SEMESTER -I

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SPECTROSCOPY AND MICROSCOPY

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26MDCPHY105**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks (SEE)–25 Internal Marks(CCE) -25

Course Objectives

- To understand the **principles and instrumentation of UV–Visibles pectroscopy** And its application in material and chemical analysis.
- To introduce the **fundamental concepts of electron and scanning probe microscopy** techniques.
- To study the **working principles, instrumentation, and sample preparation** Methods for SEM, TEM, STM, and SFM.
- To familiarize students with **applications of spectroscopic and microscopic techniques** in research and industry.

Course Outcomes

After completing this course, students will be able to:

- Explain the **principle, instrumentation, and applications of UV–Visible spectroscopy**, including Beer–Lambert's law and electronic transitions.
- Describe the **operating principles and capabilities of SEM and FESEM**, and compare them with conventional SEM.
- Understand **TEM operation**, resolution limits, imaging modes, and specimen preparation techniques.
- Differentiate between **STM and SFM**, and apply scanning probe microscopy concepts for surface topography and profilometry analysis.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**UV-VIS Spectroscopy** Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing n, a and n electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	1	15
Unit-II	**MICROSCOPY:** **Scanning Electron Microscopy (SEM)** Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM,	1	15

	Advantages over conventional SEM, Applications **Transmission Electron Microscopy (TEM)** Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation **Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)** Introduction, Instrumentation, Topography, Profilometry, Sample Requirements		

Reference Books

1. Scanning Electron Microscopy ,X-Ray Micro analysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams

2. Elementary Organic Spectroscopy, YR SharmaS. Chand.

3. Molecular Structure and Spectroscopy, GAruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26PMDCPHY106**

(Effective from June2026 under NEP-2020)

TYPEOF COURSE	**CREDIT**	**Marks**	**COURSECODE**
Discipline Core Course Practical (PDSC)	2	25 CCE +25 SEE =50	**SC2M26PMDCPHY106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE:

(1) Calibration of Magnetic Field

(2) Measurement of Frequency by CRO

(3) DIAC Characteristics

(4) Absorption Co-Efficient of Liquid using Photocell

(5) Calculate Energy band gap and its types of given UV-VIS Spectra

(6) To Find Wave number and Tentative assignment(bonding) of given IR Spectra

(7) Fibreless Optical Communication using LASER

(8) Stirling's formula(Numerical interpolation)

(9) Find value of unknown inductance using Anderson Bridge

HEMCHANDRACHARYA NORTHGUJARAT UNIVERSITY,PATAN

M.Sc. PHYSICS: SEMESTER -I

TYPEOFCOURSE: VALUE ADDED COURSE (THEORY)

COURSENAME: SCIENCE OF YOGA

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26VACPHY107**

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks(SEE)–25 Internal Marks(CCE) -25

Course Objectives

To understand

- UpaYoga: Simple preparatory exercises for Suryanamaskar
- Suryanamaskar
- Yoga namaskar
- Few Asanas : Vajrasana, Bhujnagasana, Sarvangasana
- Pranayama : Bastrika, Anulom Vilom, Bramari, Udgita and Pranayam
- Mudras
- A Few Prayers: Gayatri Mantra, Gita Slokas and Shanti mantras

Course Outcomes

After completing this course, students will be able to:

- Explain the **Theoretical Aspects of Yoga and Philosophy of Yoga** , including Yoga as a Science of Art and Classification of Yoga.
- Describe the **Physical Aspects of Yoga ,Mental Aspects of Yoga**, and **Anatomy and Physiology for Yogic practices**
- Understand Yogic therapies and **modern concept of yoga**, Different mudras during Prayers, Introduction to human body and its systems.
- Define Anatomy and Physiology and importance of yogic practice.
- Understand science of Asanas on various systems, like Respiratory, Digestive, Endocrine, Nervous and Circulatory Systems

Credit: 2

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Theoretical Aspects of Yoga and Philosophy of Yoga** Origin of Yoga and its brief Development, Meaning of Yoga and its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of Meditation and its types and principles, Classification of Yoga/ Types of Yoga, Hatha Yoga, Raja Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Ashtanga Yoga	1	15
Unit-II	**Physical Aspects of Yoga ,Mental Aspects of Yoga Anatomy and Physiology for Yogic practices** Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya, its types and principles. Yogic therapies and modern concept of yoga Meaning and importance of Prayer, Psychology of Mantras, Different mudras during Prayers Introduction to human body and its systems, Definition of Anatomy and Physiology and importance of yogic practice. Respiratory, Digestive, Endocrine, Nervous	1	15

	and Circulatory Systems, Effect of Asanas on various systems		

Reference Books:

1. B.K.S. Iyengar, “Light on Yoga”, Thorsons, 2006 edition
2. Thich Naht Hanh, “Silence”, Rider, 2015
3. Sri Rangarajan Video on “Dinacharya”
4. Sadhguru, “Inner Engineering: A Yogi's Guide to Joy” Penguin Publisher, 2016

Other References:

1. Sri Sri Ravishankar, “Patnajali Yoga Sutras”, Sri Sri Publicaitons Trust, 2012
2. Baba Ramdev Video on “Pranyaama”
3. Dr. Renu Mahatani, “Power of Pranayama”, Jaico, 2017
4. Nicolai Bachman, “the Path of the YOGA SUTRAS” Jaico, 2016
5. Anodea Judith, “Chakra Yoga”, Jaico, 2017.

Hemchandracharya North Gujarat University
PATAN - 384265

Faculty of Science

M.Sc. Physics Programme (2yearPG)
(With Research Programme) NEP 2020
With effect from June2026

Curriculum and Credit Frame work For M.Sc. SEM I To M.Sc. SEM IV

As per UGC Guidelines

(According to NATIONAL EDUCATION POLICY (NEP)–2020)

M.Sc. Physics Syllabus for Semester I TO IV

M.Sc. Physics (Course Work)

M.Sc. Physics (With Research)

Hem.North Gujarat University,Patan
PHYSICS
TWO – YEAR PG
COURSE WORK WITH RESEARCH PROGRAMME

SEM	COURSE TYPE	COURSE CODE	COURSE TITLE	THEORY / PRACTICAL	HOURS / WEEK	CREDIT	INTERNAL MARKS	EXTERNAL MARKS
I	DSCC1	SC2M26DSCCPHY101	MATHEMATICAL PHYSICS, QUANTUM, CLASSICALMECHANICS	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 102	SOLID STATE PHYSICS C-PROGRAMMING,ELECTRONICS-I AND DIGITAL ELECTRONICS	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 103	ELECTRODYNAMICS AND ELECTRONICS -II	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 104	PRACTICAL COURSE	P	4	4	50	50
	MDC1	SC2M26MDCPHY105	SPECTROSCOPY AND MICROSCOPY	T	2	2	25	25
	MDC2	SC2M26PMDCPHY106	PRACTICAL COURSE	P	2	2	25	25
	VAC	SC2M26VACPHY107	SCIENCE OF YOGA	T	2	2	25	25
II	DSCC1	SC2M26DSCCPHY201	MATHEMATICAL PHYSICS II, QUANTUM MECHANICS II, CLASSICAL MECHANICS II	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 202	SOLID STATE PHYSICS II, C-PROGRAMMING II, ELECTRONICS II	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 203	STATISTICAL MECHANICS AND MICROPROCESSOR PROGRAMME	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 204	PRACTICAL COURSE	P	4	4	50	50
	MDC	SC2M26MDCPHY205	NANO SCIENCE	T	2	2	25	25
	SEC	SC2M26PMDCPHY206	PRACTICAL COURSE	P	2	2	25	25
	VOC	SC2M26VOCPHY207	PRAMANA SIDDHANTA : INDIAN METHODS OF INQUIRY	T	2	2	25	25
	SWAYAM	SWAYAM	SWAYAM- Select from Portal					

III	DSCC1	SC2M26DSCCPHY 301	NUCLEAR PHYSICS I, ELECTRODYNEMICS	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 302	STATISTICAL MECHANICS, QUANTUM MECHANICS	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 303	ATOMIC AND MOLECULAR SPECTROSCOPY SOLID STATE PHYSICS-3	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY304	PRACTICAL COURSE	P	4	4	50	50
	DSEC1	SC2M26DSECPHY305	PHYSICS OF THE UNIVERSE	T	2	2	25	25
	DSEC2	SC2M26PDSECPHY306	PRACTICAL COURSE	T	2	2	25	25
	DSEC3	SC2M26DSECPHY307	TRANSDUCERS and ELECTRICAL MACHINES	P	2	2	25	25
IV	DSCC1	SC2MRPPHY401	RESEARCH PROJECT		16	16	200	200
	DSCC2	SC2MSPHY 401	SEMINAR		6	6	75	75

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I 101

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: MATHEMATICAL PHYSICS, QUANTUM, CLASSICALMECHANICS

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY101**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week:04 Teaching Hours per Semester: 60	THEORY	External Marks(SEE)- 50 Internal Marks(CCE) -50

Course Objectives

- To develop a strong mathematical foundation in **complex variable theory** and its applications to physical problems.
- To understand **approximation methods in quantum mechanics**, including perturbation and variation techniques for stationary states.
- To introduce the principles of **classical mechanics** through canonical transformations, Poisson brackets, Hamilton–Jacobi theory, **Small Oscillation and Rotating Frame**.

Course Outcomes

After completing this course, students will be able to:

- Apply **complex analysis technique** such as contour integration, Laurent series, and residue theorem to evaluate definite integrals.
- Analyze **quantum mechanical systems** using perturbation theory and the variation method for both non-degenerate and degenerate cases.
- Use **canonical transformations, Poisson brackets, and action–angle variables** to solve problems in classical mechanics.
- Explain the **Small Oscillation in systems, Rotating Frame,** and **Euler angles**

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples. **Reference Books** M. L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, USA (2005). 2.P. K.Chattopadhyaya,MathematicalPhysics,3rdEd., New Age International Pvt. Ltd., New Delhi (2022).	1	15

	3. G.B.Arfken and H.J.Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier, USA (2005). 4. SatyaPrakash, Mathematical Physics,6thEd.,Sultan Chand & Sons, New Delhi (2020). 5. B.S.Rajput, Mathematical Physics,28thEd.,Pragati Prakashan, Meerut (2015).		
Unit -II	**Approximation Methods for Stationary States:** Perturbation theory for discrete levels, Equations in various orders of perturbation theory, Non-degenerate case, Degenerate case-removal of degeneracy, Effect of an electric field on the energy levels of an atom (Stark effect), Two – electron atoms. Illustrative examples. **The Variational Method:** Upper bound on ground state energy, Applications to excited states, Trial function linear in variational parameters, The Hydrogen molecule, Exchange interaction. Illustrative examples. **Reference Books** 1.P.M.Mathews and K.Venkatesan, A Text Book of Quantum Mechanics, 2nd Ed. TMH, New Delhi (2011). 2.V.K.Thankappan, QuantumMechanics,5thEd., New Age International Pub., New Delhi (2020). 3.G.Aruldhas,Quantum Mechanics,2ndEd.,PHI Learning Pvt. Ltd., Delhi (2017). 4.A.Ghatak and S.Loknathan, Quantum Mechanics, 6th Ed., Trinity Press, New Delhi (2019). 5.L.I.Schiff, Quantum Mechanics,4thEd.,Tata McGraw Hill Edu., New Delhi (2017). D.J.Griffiths and D.F.Schroeter, Introduction to Quantum Mechanics, 3rd Ed., Cambridge University Press India Pvt Ltd (2019).	1	15
Unit -III	**Canonical Transformation:** Canonical transformation and Hamilton Jacobi theory: Gauge transformation, Canonical transformation, condition for transformations to be Canonical. Poisson bracket, canonical equations in terms of Poisson bracket notation, Relation between infinitesimal transformation and Poisson brackets, The Hamilton Jacobi equations, Separation of variables, Action angle variables, Properties of action angle. **Reference Books** R.G.Takwale and P.S.Puranik, Introduction to Classical Mechanics, 55th Ed., TMH, New Delhi (2016). 2. H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics,3rdEd.,PearsonIndia,NewDelhi(2011). 3. V.B.Bhatia, Classical Mechanics Classical Mechanics: With Introduction to Nonlinear Oscillations and Chaos, Narosa Pub. House, New Delhi (2001). 4. J.C.Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016).	1	15

Unit-IV	**Small Oscillation and Rotating Frame:** Stable and unstable equilibriums, Small Oscillation in a system with one degree of freedom, Small Oscillation in a system with more than one degree of freedom, Normal coordinates and Normal frequencies of vibration. Rotating Frame, Euler angles, Inertia tensor, Euler's equations of motion of a rigid body, Free motion of a rigid body, Motion of a symmetric top. **Reference Books** 1.R. G. Takwale and P. S. Puranik, Introduction to ClassicalMechanics,55thEd.,TMH,NewDelhi(2016). 2.H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics, 3rd Ed., Pearson India, New Delhi (2011). 3.V. B. Bhatia, Classical Mechanics Classical Mechanics :With Introduction to Nonlinear Oscillations and Chaos, Narosa Pub. House, New Delhi (2001). 4.J. C. Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016). 5.G. Aruldhas, Classical Mechanics, 8th Ed., PHI Learning Private Limited, New Delhi (2017).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I 102

TYPE OFCOURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SOLID STATE PHYSICS, C-PROGRAMMING,

ELECTRONICS –I & DIGITAL ELECTRONICS

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY 102**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY	External Marks (SEE)- 50 Internal Marks (CCE) -50

Course Objectives

- To understand the **electronic structure of solids**, including energy and formation and Fermi surface concepts.
- To introduce **C programming fundamentals** for problem-solving and scientific computation.
- To study the **working principles and applications of operational amplifiers** in analog circuits.
- To provide foundational knowledge of **digital electronics**, including flip-flops, registers, and counters.

Course Outcomes

After completing this course, students will be able to:

- Explain **energy band theory**, Bloch functions, and electron behavior in periodic potentials.
- Write, execute, and debug **basic C programs** using appropriate data types and variables.
- Analyze and design **OP-AMP based circuits** such as amplifiers, integrators, and waveform generators.
- Understand and apply **digital logic circuits** including flip-flops, shift registers, and counters in practical systems.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Energy Bands and Fermi Surfaces** **Energy Bands:** Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbital's in a band **Reference Books** 1.C.Kittle, Introduction to Solid State Physics, 8th Ed., Wiley Eastern Limited, New Delhi (2018).	1	15

	2.J. P. Srivastava, Elements of Solid State Physics,4thEd.,PHIL earning Private Limited, Delhi (2016). 3.C.M.Kachhava, Solid State Physics, Solid State Devices and Electronics, New Age International Publishers, New Delhi (2011).		
Unit-II	**C-Programming** **(a) Overview of C**: History of C (1.1), Importance of C (1.2), Sample Program: Printinga Message(1.3),Basic Structure of C Programs (1.8), Programming Style (1.9), Executing a C Program (1.10). **(b) Constants, Variables & Data Types**: (**Programming in C)** Introduction(2.1),Character Set(2.2),C Tokens (2.3), Keywords and Identifiers (2.4), Constants (2.5), Variables (2.6), Data Types (2.7), Declaration of Variables (2.8), Declaration of Storage Class (2.9), Assigning Values of Variables (2.10), Defining Symbolic Constants (2.11), Declaring a Variable as Constant(2.12),Declaring a Variableas Volatile(2.13), Overflow and Underflow of Data (2.14). **Basic Reference:** *Programming in ANSIC by E.Balaguruswami (THM) (3rd Edition)*	1	15
Unit-III	**The Operational Amplifier & Applications** **OPERATIONAL AMPLIFIER**: Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing –Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator, **Reference Books** 1. K. R. Botkar, Integrated Circuits, 10th Ed., Khanna Publishers, New Delhi (1987). 2.R. Boylested and L. Nashelsky,ElectronicDevicesandCircuitTheory,4thEd. , Longman Higher Education, New Delhi (1987). 3. J. D. Ryder, Electronic Fundamentals and Applications: Integrated and Discrete Systems,5thEd., PHI, New Delhi (1975). 4. A.Mottershead, Electronic Devices and Circuits: An Introduction PHI, New Delhi (1979). 5. K. V. Ramanan, Functional Electronics, Tata McGraw-Hill,NewDelhi(1984).6.R.Gayakwad,	1	15

	OP AMP & Linear Integrated Circuits, 3^{rd}Ed.,PHI, New Delhi (1993).		
Unit-IV	**DIGITALELECTRONICS** FLIPFLOP: RS FLIP-FLOPS, D FLIP-FLOPS, JK FLIP-FLOPS, and Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in serial out, serial in parallel out, parallel in serial out, parallel in parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. **Reference Books** A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications,8^{th}Ed.,TataMcGraw-Hill Publishing Company Limited, New Delhi (2014). 2. A.Kumar, Fundamentals of DigitalCircuits,4^{th}Ed., PHI Private Limited, New Delhi (2016). 3. M.Morris Mano, Digital Logic and Computer Design, PHI Private Limited, New Delhi (2006). 4. A.K.Maini, Digital Electronics Principles, Devices and Applications, 1^{st} Ed., John Wiley & Sons Ltd, England (2007).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. PHYSICS: SEMESTER –I 103

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: ELECTRODYNAMICS AND ELECTRONICS -II

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY 103**

(Effective from June2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
To study the propagation of electromagnetic waves in matter, including reflection, transmission, and frequency-dependent material response.
To understand the principles and structures of waveguides and resonant cavities For guided wave propagation.
To introduce the operation, biasing, and frequency response of FETamplifiers, including JFETs and MOSFETs.
To analyze the working and performance of power amplifiers under different classes of operation.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
Analyze electromagnetic wave behavior in linear media, including normal and oblique incidence, total internal reflection, and metallic reflection.
Explain and apply concepts of waveguides, resonant cavities, and dielectric guides in microwave and communication systems.
Design and evaluate FET amplifier circuits (common source, common drain, and common gate) for low- and high-frequency applications.
Compare and analyze power amplifier classes (A, B, push-pull, tuned amplifiers) based on efficiency, power dissipation, and performance.</td></tr>
</table>

Syllabus

Unit No.	**Content**	**Credit**	**Lect.Hrs 60**
Unit-I	**Electromagnetic waves in Matter** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B. B., Electromagnetics, Wiley Eastern,(2nded.) 3. E.C.Jordanand K.G.Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15

Unit-II	**POYNTING VECTOR AND THE FLOW OF POWER:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conductor **WAVEGUIDES:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, waveguide of rectangular cross section, co-axial waveguides, resonant cavities, dielectric waveguides, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electro dynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B.B., Electromagnetics, Wiley Eastern, (2nded.) 3. E.C.Jordan and K.G.Balmain, Electromagnetic Waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15
Unit-III	**FETAmplifiers:** FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source a.c. amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source and common drain amplifier common source amplifier at high frequency, common drain amplifier at high frequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad, PHI Pub	1	15
Unit-IV	**Power Amplifier** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers, Class-A power amplifier, and power distribution, Transformer coupled class -A amplifier, Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26PDSCCPHY 104**

(Effective from June 2026 under NEP-2020)

TYPEOF COURSE	CREDIT	Marks	COURSECODE
Discipline Core Course Practical(PDSC)	2 (Group A) and 2 (Group B)(Total4 Credit)	25 CCE +25 SEE =50 (For Both Group)	**SC2M26PDSCCPHY 104**
Teaching Hours Teaching Hours per Week:08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT COURSE:- GROUP A

(1) To find Hall co-efficient of Hall Effect
(2) To find Dead time of GM Counter
(3) To calculate self-inductance (L) of a given coil using Rayleigh Method
(4) Determination of velocity of Ultrasonic waves in a liquid/solid using Ultrasonic Interferometer
(5) To find wavelength of a monochromatic light using F P Interferometer
(6) Computer Simulation–I(Projectile Motion using MS EXCEL)
(7) Computer Simulation–II(Capacitor charging and discharging using MS EXCEL)
(8) Calculation of empty lattice energy bands(Theoretical)

LABORATORY EXPERIMENT COURSE:- GROUP B

(1) To find the frequency of Transistorized Phase shift Oscillator
(2) To find the frequency of Astable Multivibrator
(3) To obtain frequency response of FET Amplifier
(4) To find Bandwidth of OP-AMP as an Inverting OP-Amp
(5) To find LTP and UTP of Transistorized Schmitt Trigger
(6) To study characteristics of MOSFET
(7) To study characteristics of SCR
(8) Numerical solution of a polynomial(Theoretical)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. PHYSICS: SEMESTER -I

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SPECTROSCOPY AND MICROSCOPY

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26MDCPHY105**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks (SEE)–25 Internal Marks(CCE) -25

Course Objectives

- To understand the **principles and instrumentation of UV–Visibles pectroscopy** And its application in material and chemical analysis.
- To introduce the **fundamental concepts of electron and scanning probe microscopy** techniques.
- To study the **working principles, instrumentation, and sample preparation** Methods for SEM, TEM, STM, and SFM.
- To familiarize students with **applications of spectroscopic and microscopic techniques** in research and industry.

Course Outcomes

After completing this course, students will be able to:

- Explain the **principle, instrumentation, and applications of UV–Visible spectroscopy**, including Beer–Lambert's law and electronic transitions.
- Describe the **operating principles and capabilities of SEM and FESEM**, and compare them with conventional SEM.
- Understand **TEM operation**, resolution limits, imaging modes, and specimen preparation techniques.
- Differentiate between **STM and SFM**, and apply scanning probe microscopy concepts for surface topography and profilometry analysis.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**UV-VIS Spectroscopy** Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing n, a and n electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	1	15
Unit-II	**MICROSCOPY:** **Scanning Electron Microscopy (SEM)** Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM,	1	15

	Advantages over conventional SEM, Applications **Transmission Electron Microscopy (TEM)** Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation **Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)** Introduction, Instrumentation, Topography, Profilometry, Sample Requirements		

Reference Books

1. Scanning Electron Microscopy ,X-Ray Micro analysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams

2. Elementary Organic Spectroscopy, YR SharmaS. Chand.

3. Molecular Structure and Spectroscopy, GAruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26PMDCPHY106**

(Effective from June2026 under NEP-2020)

TYPEOF COURSE	**CREDIT**	**Marks**	**COURSECODE**
Discipline Core Course Practical (PDSC)	2	25 CCE +25 SEE =50	**SC2M26PMDCPHY106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE:

(1) Calibration of Magnetic Field

(2) Measurement of Frequency by CRO

(3) DIAC Characteristics

(4) Absorption Co-Efficient of Liquid using Photocell

(5) Calculate Energy band gap and its types of given UV-VIS Spectra

(6) To Find Wave number and Tentative assignment(bonding) of given IR Spectra

(7) Fibreless Optical Communication using LASER

(8) Stirling's formula(Numerical interpolation)

(9) Find value of unknown inductance using Anderson Bridge

HEMCHANDRACHARYA NORTHGUJARAT UNIVERSITY,PATAN

M.Sc. PHYSICS: SEMESTER -I

TYPEOFCOURSE: VALUE ADDED COURSE (THEORY)

COURSENAME: SCIENCE OF YOGA

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26VACPHY107**

<table>
<tr><td rowspan="2">Total Credits: 02
Teaching Hours per Week:02
Teaching Hours per Semester: 30</td><td rowspan="2">THEORY</td><td>External Marks(SEE)–25</td></tr>
<tr><td>Internal Marks(CCE) -25</td></tr>
<tr><td colspan="3">Course Objectives
To understand
• UpaYoga: Simple preparatory exercises for Suryanamaskar
• Suryanamaskar
• Yoga namaskar
• Few Asanas : Vajrasana, Bhujnagasana, Sarvangasana
• Pranayama : Bastrika, Anulom Vilom, Bramari, Udgita and Pranayam
• Mudras
• A Few Prayers: Gayatri Mantra, Gita Slokas and Shanti mantras</td></tr>
<tr><td colspan="3">Course Outcomes
After completing this course, students will be able to:
• Explain the Theoretical Aspects of Yoga and Philosophy of Yoga , including Yoga as a Science of Art and Classification of Yoga.
• Describe the Physical Aspects of Yoga ,Mental Aspects of Yoga, and Anatomy and Physiology for Yogic practices
• Understand Yogic therapies and modern concept of yoga, Different mudras during Prayers, Introduction to human body and its systems.
• Define Anatomy and Physiology and importance of yogic practice.
• Understand science of Asanas on various systems, like Respiratory, Digestive, Endocrine, Nervous and Circulatory Systems</td></tr>
</table>

Credit: 2

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Theoretical Aspects of Yoga and Philosophy of Yoga** Origin of Yoga and its brief Development, Meaning of Yoga and its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of Meditation and its types and principles, Classification of Yoga/ Types of Yoga, Hatha Yoga, Raja Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Ashtanga Yoga	1	15
Unit-II	**Physical Aspects of Yoga ,Mental Aspects of Yoga Anatomy and Physiology for Yogic practices** Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya, its types and principles. Yogic therapies and modern concept of yoga Meaning and importance of Prayer, Psychology of Mantras, Different mudras during Prayers Introduction to human body and its systems, Definition of Anatomy and Physiology and importance of yogic practice. Respiratory, Digestive, Endocrine, Nervous	1	15

	and Circulatory Systems, Effect of Asanas on various systems		

Reference Books:

1. B.K.S. Iyengar, “Light on Yoga”, Thorsons, 2006 edition
2. Thich Naht Hanh, “Silence”, Rider, 2015
3. Sri Rangarajan Video on “Dinacharya”
4. Sadhguru, “Inner Engineering: A Yogi's Guide to Joy” Penguin Publisher, 2016

Other References:

1. Sri Sri Ravishankar, “Patnajali Yoga Sutras”, Sri Sri Publicaitons Trust, 2012
2. Baba Ramdev Video on “Pranyaama”
3. Dr. Renu Mahatani, “Power of Pranayama”, Jaico, 2017
4. Nicolai Bachman, “the Path of the YOGA SUTRAS” Jaico, 2016
5. Anodea Judith, “Chakra Yoga”, Jaico, 2017.

Hemchandracharya North Gujarat University
PATAN - 384265

Faculty of Science

M.Sc. Physics Programme (2yearPG)
(Only Research Programme) NEP 2020
With effect from June2026

Curriculum and Credit Frame work For M.Sc. SEM I To M.Sc. SEM IV

As per UGC Guidelines

(According to NATIONAL EDUCATION POLICY (NEP)–2020)

M.Sc. Physics Syllabus for Semester I TO IV

M.Sc. Physics (Course Work)

M.Sc. Physics (Only Research)

ONLY RESEARCH PROGRAMME

SEM	COURSE TYPE	COURSE CODE	COURSE TITLE	THEORY / PRACTICAL	HOURS / WEEK	CREDIT	INTERNAL MARKS	EXTERNAL MARKS
I	DSCC1	SC2M26DSCCPHY101	MATHEMATICAL PHYSICS, QUANTUM, CLASSICALMECHANICS	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 102	SOLID STATE PHYSICS C-PROGRAMMING,ELECTRONICS-I AND DIGITAL ELECTRONICS	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 103	ELECTRODYNAMICS AND ELECTRONICS -II	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 104	PRACTICAL COURSE	P	4	4	50	50
	MDC1	SC2M26MDCPHY105	SPECTROSCOPY AND MICROSCOPY	T	2	2	25	25
	MDC2	SC2M26PMDCPHY106	PRACTICAL COURSE	P	2	2	25	25
	VAC	SC2M26VACPHY107	SCIENCE OF YOGA	T	2	2	25	25
II	DSCC1	SC2M26DSCCPHY201	MATHEMATICAL PHYSICS II, QUANTUM MECHANICS II, CLASSICAL MECHANICS II	T	4	4	50	50
	DSCC2	SC2M26DSCCPHY 202	SOLID STATE PHYSICS II, C-PROGRAMMING II, ELECTRONICS II	T	4	4	50	50
	DSCC3	SC2M26DSCCPHY 203	STATISTICAL MECHANICS AND MICROPROCESSOR PROGRAMME	T	4	4	50	50
	DSCC4	SC2M26PDSCCPHY 204	PRACTICAL COURSE	P	4	4	50	50
	MDC	SC2M26SECPHY205	NANO SCIENCE	T	2	2	25	25
	SEC	SC2M26PMDCPHY206	PRACTICAL COURSE	P	2	2	25	25
	VOC	SC2M26VOCPHY207	PRAMANA SIDDHANTA : INDIAN METHODS OF INQUIRY	T	2	2	25	25
	SWAYAM	SWAYAM	SWAYAM- Select from Portal					
III	DSCC1	SC2MRPPHY 301	RESEARCH PROJECT		22	22	275	275
IV	DSCC1	SC2MRPPHY401	RESEARCH PROJECT		22	22	275	275

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I 101

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: MATHEMATICAL PHYSICS, QUANTUM, CLASSICALMECHANICS

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY101**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week:04 Teaching Hours per Semester: 60	THEORY	External Marks(SEE)- 50 Internal Marks(CCE) -50

Course Objectives

- To develop a strong mathematical foundation in **complex variable theory** and its applications to physical problems.
- To understand **approximation methods in quantum mechanics**, including perturbation and variation techniques for stationary states.
- To introduce the principles of **classical mechanics** through canonical transformations, Poisson brackets, Hamilton–Jacobi theory, **Small Oscillation and Rotating Frame**.

Course Outcomes

After completing this course, students will be able to:

- Apply **complex analysis technique** such as contour integration, Laurent series, and residue theorem to evaluate definite integrals.
- Analyze **quantum mechanical systems** using perturbation theory and the variation method for both non-degenerate and degenerate cases.
- Use **canonical transformations, Poisson brackets, and action–angle variables** to solve problems in classical mechanics.
- Explain the **Small Oscillation in systems, Rotating Frame,** and **Euler angles**

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples. **Reference Books** M. L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, USA (2005). 2.P. K.Chattopadhyaya,MathematicalPhysics,3rdEd., New Age International Pvt. Ltd., New Delhi (2022).	1	15

	3. G.B.Arfken and H.J.Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier, USA (2005). 4. SatyaPrakash, Mathematical Physics,6thEd.,Sultan Chand & Sons, New Delhi (2020). 5. B.S.Rajput, Mathematical Physics,28thEd.,Pragati Prakashan, Meerut (2015).		
Unit -II	**Approximation Methods for Stationary States:** Perturbation theory for discrete levels, Equations in various orders of perturbation theory, Non-degenerate case, Degenerate case-removal of degeneracy, Effect of an electric field on the energy levels of an atom (Stark effect), Two –electron atoms. Illustrative examples. **The Variational Method:** Upper bound on ground state energy, Applications to excited states, Trial function linear in variational parameters, The Hydrogen molecule, Exchange interaction. Illustrative examples. **Reference Books** 1.P.M.Mathews and K.Venkatesan, A Text Book of Quantum Mechanics, 2nd Ed. TMH, New Delhi (2011). 2.V.K.Thankappan, QuantumMechanics,5thEd., New Age International Pub., New Delhi (2020). 3.G.Aruldhas,Quantum Mechanics,2ndEd.,PHI Learning Pvt. Ltd., Delhi (2017). 4.A.Ghatak and S.Loknathan, Quantum Mechanics, 6th Ed., Trinity Press, New Delhi (2019). 5.L.I.Schiff, Quantum Mechanics,4thEd.,Tata McGraw Hill Edu., New Delhi (2017). D.J.Griffiths and D.F.Schroeter, Introduction to Quantum Mechanics, 3rd Ed., Cambridge University Press India Pvt Ltd (2019).	1	15
Unit -III	**Canonical Transformation:** Canonical transformation and Hamilton Jacobi theory: Gauge transformation, Canonical transformation, condition for transformations to be Canonical. Poisson bracket, canonical equations in terms of Poisson bracket notation, Relation between infinitesimal transformation and Poisson brackets, The Hamilton Jacobi equations, Separation of variables, Action angle variables, Properties of action angle. **Reference Books** R.G.Takwale and P.S.Puranik, Introduction to Classical Mechanics, 55th Ed., TMH, New Delhi (2016). 2. H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics,3rdEd.,PearsonIndia,NewDelhi(2011). 3. V.B.Bhatia, Classical Mechanics Classical Mechanics: With Introduction to Nonlinear Oscillations and Chaos, Narosa Pub. House, New Delhi (2001). 4. J.C.Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016).	1	15

Unit-IV	**Small Oscillation and Rotating Frame:** Stable and unstable equilibriums, Small Oscillation in a system with one degree of freedom, Small Oscillation in a system with more than one degree of freedom, Normal coordinates and Normal frequencies of vibration. Rotating Frame, Euler angles, Inertia tensor, Euler's equations of motion of a rigid body, Free motion of a rigid body, Motion of a symmetric top. **Reference Books** 1.R. G. Takwale and P. S. Puranik, Introduction to ClassicalMechanics,55thEd.,TMH,NewDelhi(2016). 2.H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics, 3rd Ed., Pearson India, New Delhi (2011). 3.V. B. Bhatia, Classical Mechanics Classical Mechanics :With Introduction to Nonlinear Oscillations and Chaos, Narosa Pub. House, New Delhi (2001). 4.J. C. Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016). 5.G. Aruldhas, Classical Mechanics, 8th Ed., PHI Learning Private Limited, New Delhi (2017).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I 102

TYPE OFCOURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SOLID STATE PHYSICS, C-PROGRAMMING,

ELECTRONICS –I & DIGITAL ELECTRONICS

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY 102**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY	External Marks (SEE)- 50 Internal Marks (CCE) -50

Course Objectives

- To understand the **electronic structure of solids**, including energy and formation and Fermi surface concepts.
- To introduce **C programming fundamentals** for problem-solving and scientific computation.
- To study the **working principles and applications of operational amplifiers** in analog circuits.
- To provide foundational knowledge of **digital electronics**, including flip-flops, registers, and counters.

Course Outcomes

After completing this course, students will be able to:

- Explain **energy band theory**, Bloch functions, and electron behavior in periodic potentials.
- Write, execute, and debug **basic C programs** using appropriate data types and variables.
- Analyze and design **OP-AMP based circuits** such as amplifiers, integrators, and waveform generators.
- Understand and apply **digital logic circuits** including flip-flops, shift registers, and counters in practical systems.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Energy Bands and Fermi Surfaces** **Energy Bands:** Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbital's in a band **Reference Books** 1.C.Kittle, Introduction to Solid State Physics, 8^{th}Ed., Wiley Eastern Limited, New Delhi (2018).	1	15

	2.J. P. Srivastava, Elements of Solid State Physics,4thEd.,PHIL earning Private Limited, Delhi (2016). 3.C.M.Kachhava, Solid State Physics, Solid State Devices and Electronics, New Age International Publishers, New Delhi (2011).		
Unit-II	**C-Programming** **(a) Overview of C**: History of C (1.1), Importance of C (1.2), Sample Program: Printinga Message(1.3),Basic Structure of C Programs (1.8), Programming Style (1.9), Executing a C Program (1.10). **(b) Constants, Variables & Data Types**: (**Programming in C)** Introduction(2.1),Character Set(2.2),C Tokens (2.3), Keywords and Identifiers (2.4), Constants (2.5), Variables (2.6), Data Types (2.7), Declaration of Variables (2.8), Declaration of Storage Class (2.9), Assigning Values of Variables (2.10), Defining Symbolic Constants (2.11), Declaring a Variable as Constant(2.12),Declaring a Variableas Volatile(2.13), Overflow and Underflow of Data (2.14). **Basic Reference:** *Programming in ANSIC by E.Balaguruswami (THM) (3rd Edition)*	1	15
Unit-III	**The Operational Amplifier & Applications** **OPERATIONAL AMPLIFIER**: Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing –Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator, **Reference Books** 1. K. R. Botkar, Integrated Circuits, 10th Ed., Khanna Publishers, New Delhi (1987). 2.R. Boylested and L. Nashelsky,ElectronicDevicesandCircuitTheory,4thEd. , Longman Higher Education, New Delhi (1987). 3. J. D. Ryder, Electronic Fundamentals and Applications: Integrated and Discrete Systems,5thEd., PHI, New Delhi (1975). 4. A.Mottershead, Electronic Devices and Circuits: An Introduction PHI, New Delhi (1979). 5. K. V. Ramanan, Functional Electronics, Tata McGraw-Hill,NewDelhi(1984).6.R.Gayakwad,	1	15

	OP AMP & Linear Integrated Circuits, 3rdEd.,PHI, New Delhi (1993).		
Unit-IV	**DIGITALELECTRONICS** FLIPFLOP: RS FLIP-FLOPS, D FLIP-FLOPS, JK FLIP-FLOPS, and Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in serial out, serial in parallel out, parallel in serial out, parallel in parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. **Reference Books** A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications,8thEd.,TataMcGraw-Hill Publishing Company Limited, New Delhi (2014). 2. A.Kumar, Fundamentals of DigitalCircuits,4thEd., PHI Private Limited, New Delhi (2016). 3. M.Morris Mano, Digital Logic and Computer Design, PHI Private Limited, New Delhi (2006). 4. A.K.Maini, Digital Electronics Principles, Devices and Applications, 1st Ed., John Wiley & Sons Ltd, England (2007).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. PHYSICS: SEMESTER –I 103

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: ELECTRODYNAMICS AND ELECTRONICS -II

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26DSCCPHY 103**

(Effective from June2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
To study the propagation of electromagnetic waves in matter, including reflection, transmission, and frequency-dependent material response.
To understand the principles and structures of waveguides and resonant cavities For guided wave propagation.
To introduce the operation, biasing, and frequency response of FETamplifiers, including JFETs and MOSFETs.
To analyze the working and performance of power amplifiers under different classes of operation.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
Analyze electromagnetic wave behavior in linear media, including normal and oblique incidence, total internal reflection, and metallic reflection.
Explain and apply concepts of waveguides, resonant cavities, and dielectric guides in microwave and communication systems.
Design and evaluate FET amplifier circuits (common source, common drain, and common gate) for low- and high-frequency applications.
Compare and analyze power amplifier classes (A, B, push-pull, tuned amplifiers) based on efficiency, power dissipation, and performance.</td></tr>
</table>

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Electromagnetic waves in Matter** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B. B., Electromagnetics, Wiley Eastern,(2nded.) 3. E.C.Jordanand K.G.Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15

Unit-II	**POYNTING VECTOR AND THE FLOW OF POWER:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conductor **WAVEGUIDES:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, waveguide of rectangular cross section, co-axial waveguides, resonant cavities, dielectric waveguides, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electro dynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B.B., Electromagnetics, Wiley Eastern, (2nded.) 3. E.C.Jordan and K.G.Balmain, Electromagnetic Waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15
Unit-III	**FETAmplifiers:** FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source a.c. amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source and common drain amplifier common source amplifier at high frequency, common drain amplifier at high frequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad, PHI Pub	1	15
Unit-IV	**Power Amplifier** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers, Class-A power amplifier, and power distribution, Transformer coupled class -A amplifier, Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26PDSCCPHY 104**

(Effective from June 2026 under NEP-2020)

TYPEOF COURSE	CREDIT	Marks	COURSECODE
Discipline Core Course Practical(PDSC)	2 (Group A) and 2 (Group B)(Total4 Credit)	25 CCE +25 SEE =50 (For Both Group)	**SC2M26PDSCCPHY 104**
Teaching Hours Teaching Hours per Week:08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT COURSE:- GROUP A

(1) To find Hall co-efficient of Hall Effect
(2) To find Dead time of GM Counter
(3) To calculate self-inductance (L) of a given coil using Rayleigh Method
(4) Determination of velocity of Ultrasonic waves in a liquid/solid using Ultrasonic Interferometer
(5) To find wavelength of a monochromatic light using F P Interferometer
(6) Computer Simulation–I(Projectile Motion using MS EXCEL)
(7) Computer Simulation–II(Capacitor charging and discharging using MS EXCEL)
(8) Calculation of empty lattice energy bands(Theoretical)

LABORATORY EXPERIMENT COURSE:- GROUP B

(1) To find the frequency of Transistorized Phase shift Oscillator
(2) To find the frequency of Astable Multivibrator
(3) To obtain frequency response of FET Amplifier
(4) To find Bandwidth of OP-AMP as an Inverting OP-Amp
(5) To find LTP and UTP of Transistorized Schmitt Trigger
(6) To study characteristics of MOSFET
(7) To study characteristics of SCR
(8) Numerical solution of a polynomial(Theoretical)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. PHYSICS: SEMESTER -I

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SPECTROSCOPY AND MICROSCOPY

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26MDCPHY105**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks (SEE)–25 Internal Marks(CCE) -25

Course Objectives

- To understand the **principles and instrumentation of UV–Visibles pectroscopy** And its application in material and chemical analysis.
- To introduce the **fundamental concepts of electron and scanning probe microscopy** techniques.
- To study the **working principles, instrumentation, and sample preparation** Methods for SEM, TEM, STM, and SFM.
- To familiarize students with **applications of spectroscopic and microscopic techniques** in research and industry.

Course Outcomes

After completing this course, students will be able to:

- Explain the **principle, instrumentation, and applications of UV–Visible spectroscopy**, including Beer–Lambert's law and electronic transitions.
- Describe the **operating principles and capabilities of SEM and FESEM**, and compare them with conventional SEM.
- Understand **TEM operation**, resolution limits, imaging modes, and specimen preparation techniques.
- Differentiate between **STM and SFM**, and apply scanning probe microscopy concepts for surface topography and profilometry analysis.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**UV-VIS Spectroscopy** Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing n, a and n electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	1	15
Unit-II	**MICROSCOPY:** **Scanning Electron Microscopy (SEM)** Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM,	1	15

	Advantages over conventional SEM, Applications **Transmission Electron Microscopy (TEM)** Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation **Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)** Introduction, Instrumentation, Topography, Profilometry, Sample Requirements		

Reference Books

1. Scanning Electron Microscopy ,X-Ray Micro analysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams

2. Elementary Organic Spectroscopy, YR SharmaS. Chand.

3. Molecular Structure and Spectroscopy, GAruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. PHYSICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26PMDCPHY106**

(Effective from June2026 under NEP-2020)

TYPEOF COURSE	**CREDIT**	**Marks**	**COURSECODE**
Discipline Core Course Practical (PDSC)	2	25 CCE +25 SEE =50	**SC2M26PMDCPHY106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE:

(1) Calibration of Magnetic Field

(2) Measurement of Frequency by CRO

(3) DIAC Characteristics

(4) Absorption Co-Efficient of Liquid using Photocell

(5) Calculate Energy band gap and its types of given UV-VIS Spectra

(6) To Find Wave number and Tentative assignment(bonding) of given IR Spectra

(7) Fibreless Optical Communication using LASER

(8) Stirling's formula(Numerical interpolation)

(9) Find value of unknown inductance using Anderson Bridge

HEMCHANDRACHARYA NORTHGUJARAT UNIVERSITY,PATAN

M.Sc. PHYSICS: SEMESTER -I

TYPEOFCOURSE: VALUE ADDED COURSE (THEORY)

COURSENAME: SCIENCE OF YOGA

PROGRAMME CODE: **SCIPG101** COURSE CODE: **SC2M26VACPHY107**

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks(SEE)–25 Internal Marks(CCE) -25

Course Objectives

To understand

- UpaYoga: Simple preparatory exercises for Suryanamaskar
- Suryanamaskar
- Yoga namaskar
- Few Asanas : Vajrasana, Bhujnagasana, Sarvangasana
- Pranayama : Bastrika, Anulom Vilom, Bramari, Udgita and Pranayam
- Mudras
- A Few Prayers: Gayatri Mantra, Gita Slokas and Shanti mantras

Course Outcomes

After completing this course, students will be able to:

- Explain the **Theoretical Aspects of Yoga and Philosophy of Yoga** , including Yoga as a Science of Art and Classification of Yoga.
- Describe the **Physical Aspects of Yoga ,Mental Aspects of Yoga**, and **Anatomy and Physiology for Yogic practices**
- Understand Yogic therapies and **modern concept of yoga**, Different mudras during Prayers, Introduction to human body and its systems.
- Define Anatomy and Physiology and importance of yogic practice.
- Understand science of Asanas on various systems, like Respiratory, Digestive, Endocrine, Nervous and Circulatory Systems

Credit: 2

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Theoretical Aspects of Yoga and Philosophy of Yoga** Origin of Yoga and its brief Development, Meaning of Yoga and its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of Meditation and its types and principles, Classification of Yoga/ Types of Yoga, Hatha Yoga, Raja Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Ashtanga Yoga	1	15
Unit-II	**Physical Aspects of Yoga ,Mental Aspects of Yoga** **Anatomy and Physiology for Yogic practices** Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya, its types and principles. Yogic therapies and modern concept of yoga Meaning and importance of Prayer, Psychology of Mantras, Different mudras during Prayers Introduction to human body and its systems, Definition of Anatomy and Physiology and importance of yogic practice. Respiratory, Digestive, Endocrine, Nervous	1	15

	and Circulatory Systems, Effect of Asanas on various systems		

Reference Books:

1. B.K.S. Iyengar, “Light on Yoga”, Thorsons, 2006 edition
2. Thich Naht Hanh, “Silence”, Rider, 2015
3. Sri Rangarajan Video on “Dinacharya”
4. Sadhguru, “Inner Engineering: A Yogi's Guide to Joy” Penguin Publisher, 2016

Other References:

1. Sri Sri Ravishankar, “Patnajali Yoga Sutras”, Sri Sri Publicaitons Trust, 2012
2. Baba Ramdev Video on “Pranyaama”
3. Dr. Renu Mahatani, “Power of Pranayama”, Jaico, 2017
4. Nicolai Bachman, “the Path of the YOGA SUTRAS” Jaico, 2016
5. Anodea Judith, “Chakra Yoga”, Jaico, 2017.

Hemchandracharya North Gujarat University
PATAN - 384265

Faculty of Science

M.Sc. ELECTRONICS Programme (2yearPG)
(Only Course Work Program) NEP 2020

With effect from June2026

Curriculum and Credit Frame work For M.Sc. SEM I To M.Sc. SEM IV

As per UGC Guidelines

(According to NATIONAL EDUCATION POLICY (NEP)–2020)

M.Sc. ELECTRONICS Syllabus for Semester I TO IV

M.Sc. ELECTRONICS (Course Work)

M.Sc. ELECTRONICS (Only Course Work)

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

M.Sc. Electronics: SEMESTER –I 109

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: : **MATHEMATICAL PHYSICS- 1**, **SEMICONDUCTOR PHYSICS AND POWER SUPPLY**

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE101**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week:04 Teaching Hours per Semester: 60	THEORY	External Marks(SEE)- 50 Internal Marks(CCE) -50

Course Objectives

- To develop a strong mathematical foundation in **complex variable theory** and its applications to physical problems.
- To understand different types of Semiconductor fundamentals, Wave Shaping and power supply.

Course Outcomes

After completing this course, students will be able to understand:

- Apply **complex analysis technique** such as contour integration, Laurent series, and residue theorem to evaluate definite integrals.
- Designing of Amplifiers, filters and power supplies.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples. **Reference Books** M. L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, USA (2005). 2.P. K.Chattopadhyaya,MathematicalPhysics,3rdEd., New Age International Pvt. Ltd., New Delhi (2022).	1	15

	3. G.B.Arfken and H.J.Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier, USA (2005). 4. SatyaPrakash, Mathematical Physics,6thEd.,Sultan Chand & Sons, New Delhi (2020). 5. B.S.Rajput, Mathematical Physics,28thEd.,Pragati Prakashan, Meerut (2015).		
Unit -II	**Semiconductor Physics** The energy band theory of crystals, Insulators, Semiconductors and Metals, Mobility and Conductivity, Electrons and holes in an Intrinsic Semiconductor, Donor and Acceptor impurities, Charge densities, Hall Effect, Conductivity Modulation, Generation and recombination of charges Diffusion, Continuity Equation, Injected Minority carrier Charge, Potential Variation within a graded semiconductor, Energy distribution of electrons in a metal, Fermi-Dirac function, Densities of states, Electron emission from a metal, Carrier concentration in an intrinsic semi, fermi-level, band Structure of an open-circuit PN characteristic, dynamic diffusion capacitance. Schottky barriers, Rectifying contacts, Ohmic contacts, Typical schottky barriers, metal insulator semiconductor diodes: Ideal metal insulator semiconductor (MIS) diode, Surface space charge region, Ideal MIS curves.	1	15
Unit -III	• **WAVE SHAPING CIRCUIT:** linear wave shaping, the high pass RC circuit, High pass RC circuit as differentiator, the Low pass RC circuit, Low pass circuit as an integrator, Non Linear wave shaping, PN junction diode switching times.	1	15

Unit-IV	Rectifiers(Halfwave, Fullwave and Bridge), Three terminal Voltage regulators, Fixed and Adjustable Voltage Regulators (78XX, LM317), Heat Sink, Dual Power supply (LM320, LM317), Basic Switching Regulator and its characteristics 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad,PHI Pub.	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I 102

TYPE OFCOURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SOLID STATE PHYSICS, C-PROGRAMMING,

ELECTRONICS –I & DIGITAL ELECTRONICS

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE102**

(Effective from June 2026 under NEP- 2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week: 04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks (SEE)- 50</td></tr>
<tr><td>Internal Marks (CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
• To understand the electronic structure of solids, including energy and formation and Fermi surface concepts.
• To introduce C programming fundamentals for problem-solving and scientific computation.
• To study the working principles and applications of operational amplifiers in analog circuits.
• To provide foundational knowledge of digital electronics, including flip-flops, registers, and counters.</td></tr>
<tr><td colspan="3">Course Outcomes
After completing this course, students will be able to:
• Explain energy band theory, Bloch functions, and electron behavior in periodic potentials.
• Write, execute, and debug basic C programs using appropriate data types and variables.
• Analyze and design OP-AMP based circuits such as amplifiers, integrators, and waveform generators.
• Understand and apply digital logic circuits including flip-flops, shift registers, and counters in practical systems.</td></tr>
</table>

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Energy Bands and Fermi Surfaces** **Energy Bands:** Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbital's in a band **Reference Books** 1.C.Kittle, Introduction to Solid State Physics, 8thEd., Wiley Eastern Limited, New Delhi (2018).	1	15

	2.J. P. Srivastava, Elements of Solid State Physics,4th Ed.,PHIL earning Private Limited, Delhi (2016). 3.C.M.Kachhava, Solid State Physics, Solid State Devices and Electronics, New Age International Publishers, New Delhi (2011).		
Unit-II	**C-Programming** **(a) Overview of C**: History of C (1.1), Importance of C (1.2), Sample Program: Printinga Message(1.3),Basic Structure of C Programs (1.8), Programming Style (1.9), Executing a C Program (1.10). **(b) Constants, Variables & Data Types**: (**Programming in C)** Introduction(2.1),Character Set(2.2),C Tokens (2.3), Keywords and Identifiers (2.4), Constants (2.5), Variables (2.6), Data Types (2.7), Declaration of Variables (2.8), Declaration of Storage Class (2.9), Assigning Values of Variables (2.10), Defining Symbolic Constants (2.11), Declaring a Variable as Constant(2.12),Declaring a Variableas Volatile(2.13), Overflow and Underflow of Data (2.14). **Basic Reference:** *Programming in ANSIC by E.Balaguruswami (THM) (3rd Edition)*	1	15
Unit-III	**The Operational Amplifier & Applications** **OPERATIONAL AMPLIFIER**: Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing –Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator, **Reference Books** 1. K. R. Botkar, Integrated Circuits, 10th Ed., Khanna Publishers, New Delhi (1987). 2.R. Boylested and L. Nashelsky,ElectronicDevicesandCircuitTheory,4thEd. , Longman Higher Education, New Delhi (1987). 3. J. D. Ryder, Electronic Fundamentals and Applications: Integrated and Discrete Systems,5thEd., PHI, New Delhi (1975). 4. A.Mottershead, Electronic Devices and Circuits: An Introduction PHI, New Delhi (1979). 5. K. V. Ramanan, Functional Electronics, Tata McGraw-Hill,NewDelhi(1984).6.R.Gayakwad,	1	15

	OP AMP & Linear Integrated Circuits, 3rdEd.,PHI, New Delhi (1993).		
Unit-IV	**DIGITALELECTRONICS** FLIPFLOP: RS FLIP-FLOPS, D FLIP-FLOPS, JK FLIP-FLOPS, and Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in serial out, serial in parallel out, parallel in serial out, parallel in parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. **Reference Books** A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications,8thEd.,TataMcGraw-Hill Publishing Company Limited, New Delhi (2014). 2. A.Kumar, Fundamentals of DigitalCircuits,4thEd., PHI Private Limited, New Delhi (2016). 3. M.Morris Mano, Digital Logic and Computer Design, PHI Private Limited, New Delhi (2006). 4. A.K.Maini, Digital Electronics Principles, Devices and Applications, 1st Ed., John Wiley & Sons Ltd, England (2007).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. ELECTRONICS: SEMESTER –I 103

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: ELECTRODYNAMICS AND ELECTRONICS -II PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE103**

(Effective from June2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
• To study the propagation of electromagnetic waves in matter, including reflection, transmission, and frequency-dependent material response.
• To understand the principles and structures of waveguides and resonant cavities For guided wave propagation.
• To introduce the operation, biasing, and frequency response of FETamplifiers, including JFETs and MOSFETs.
• To analyze the working and performance of power amplifiers under different classes of operation.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
• Analyze electromagnetic wave behavior in linear media, including normal and oblique incidence, total internal reflection, and metallic reflection.
• Explain and apply concepts of waveguides, resonant cavities, and dielectric guides in microwave and communication systems.
• Design and evaluate FET amplifier circuits (common source, common drain, and common gate) for low- and high-frequency applications.
• Compare and analyze power amplifier classes (A, B, push-pull, tuned amplifiers) based on efficiency, power dissipation, and performance.</td></tr>
</table>

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Electromagnetic waves in Matter** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B. B., Electromagnetics, Wiley Eastern,(2nded.) 3. E.C.Jordanand K.G.Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15

Unit-II	**POYNTING VECTOR AND THE FLOW OF POWER:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conductor **WAVEGUIDES:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, waveguide of rectangular cross section, co-axial waveguides, resonant cavities, dielectric waveguides, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electro dynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B.B., Electromagnetics, Wiley Eastern, (2nded.) 3. E.C.Jordan and K.G.Balmain, Electromagnetic Waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15
Unit-III	**FETAmplifiers:** FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source a.c. amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source and common drain amplifier common source amplifier at high frequency, common drain amplifier at high frequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad, PHI Pub	1	15
Unit-IV	**Power Amplifier** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers, Class-A power amplifier, and power distribution, Transformer coupled class -A amplifier, Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26PDSCCELE104**

(Effective from June 2026 under NEP-2020)

TYPEOF COURSE	**CREDIT**	**Marks**	**COURSECODE**
Discipline Core Course Practical(PDSC)	2 (Group A) and 2 (Group B)(Total4 Credit)	25 CCE +25 SEE =50 (For Both Group)	**SC2M26PDSCCELE104**
Teaching Hours Teaching Hours per Week:08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT COURSE:- GROUP A

(1) To find Hall co-efficient of Hall Effect
(2) Computer (MS- WORD)
(3) To calculate self-inductance (L) of a given coil using Rayleigh Method
(4) Determination of velocity of Ultrasonic waves in a liquid/solid using Ultrasonic Interferometer
(5) To find wavelength of a monochromatic light using F P Interferometer
(6) Computer Simulation–I(Projectile Motion using MS EXCEL)
(7) Computer Simulation–II(Capacitor charging and discharging using MS EXCEL)
(8) Code conversion(Binary, Octal, Decimal and Hexadecimal)

LABORATORY EXPERIMENT COURSE:- GROUP B

(1) To find the frequency of Transistorized Phase shift Oscillator
(2) To find the frequency of Astable Multivibrator
(3) To obtain frequency response of FET Amplifier
(4) To find Bandwidth of OP-AMP as an Inverting OP-Amp
(5) To find LTP and UTP of Transistorized Schmitt Trigger
(6) To study characteristics of MOSFET
(7) To study characteristics of SCR
(8) Regulated Power Supply(78xx & 79xx).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. ELECTRONICS: SEMESTER -I

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SPECTROSCOPY AND MICROSCOPY

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26MDCELE105**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks (SEE)–25 Internal Marks(CCE) -25

Course Objectives

- To understand the **principles and instrumentation of UV–Visibles pectroscopy** And its application in material and chemical analysis.
- To introduce the **fundamental concepts of electron and scanning probe microscopy** techniques.
- To study the **working principles, instrumentation, and sample preparation** Methods for SEM, TEM, STM, and SFM.
- To familiarize students with **applications of spectroscopic and microscopic techniques** in research and industry.

Course Outcomes

After completing this course, students will be able to:

- Explain the **principle, instrumentation, and applications of UV–Visible spectroscopy**, including Beer–Lambert's law and electronic transitions.
- Describe the **operating principles and capabilities of SEM and FESEM**, and compare them with conventional SEM.
- Understand **TEM operation**, resolution limits, imaging modes, and specimen preparation techniques.
- Differentiate between **STM and SFM**, and apply scanning probe microscopy concepts for surface topography and profilometry analysis.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**UV-VIS Spectroscopy** Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing n, a and n electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	1	15
Unit-II	**MICROSCOPY:** **Scanning Electron Microscopy (SEM)** Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM,	1	15

	Advantages over conventional SEM, Applications **Transmission Electron Microscopy (TEM)** Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation **Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)** Introduction, Instrumentation, Topography, Profilometry, Sample Requirements		

Reference Books

1. Scanning Electron Microscopy ,X-Ray Micro analysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams

2. Elementary Organic Spectroscopy, YR SharmaS. Chand.

3. Molecular Structure and Spectroscopy, GAruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG109** COURSE CODE: **SC2M26PMDCELE106**

(Effective from June2026 under NEP-2020)

<table>
<tr><th>TYPEOF COURSE</th><th>CREDIT</th><th>Marks</th><th>COURSECODE</th></tr>
<tr><td>Discipline Core Course Practical (PDSC)</td><td>2</td><td>25 CCE +25 SEE =50</td><td>SC2M26PMDCELE106</td></tr>
<tr><td colspan="4">Teaching Hours
Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester)
Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)</td></tr>
</table>

LABORATORY EXPERIMENTS COURSE:

(1) Calibration of Magnetic Field

(2) Measurement of Frequency by CRO

(3) DIAC Characteristics

(4) Absorption Co-Efficient of Liquid using Photocell

(5) Calculate Energy band gap and its types of given UV-VIS Spectra

(6) To Find Wave number and Tentative assignment(bonding) of given IR Spectra

(7) Fibreless Optical Communication using LASER

AND/OR

Project Work:

The student needs to submit Project report/Dissertation and can show demonstration of the project.

HEMCHANDRACHARYA NORTHGUJARAT UNIVERSITY,PATAN

M.Sc. ELECTRONICS: SEMESTER -I

TYPEOFCOURSE: VALUE ADDED COURSE (THEORY)

COURSENAME: SCIENCE OF YOGA

PROGRAMME CODE: **SCIPG109** COURSE CODE: **SC2M26VACELE107**

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks(SEE)–25 Internal Marks(CCE) -25

Course Objectives

To understand

- UpaYoga: Simple preparatory exercises for Suryanamaskar
- Suryanamaskar
- Yoga namaskar
- Few Asanas : Vajrasana, Bhujnagasana, Sarvangasana
- Pranayama : Bastrika, Anulom Vilom, Bramari, Udgita and Pranayam
- Mudras
- A Few Prayers: Gayatri Mantra, Gita Slokas and Shanti mantras

Course Outcomes

After completing this course, students will be able to:

- Explain the **Theoretical Aspects of Yoga and Philosophy of Yoga** , including Yoga as a Science of Art and Classification of Yoga.
- Describe the **Physical Aspects of Yoga ,Mental Aspects of Yoga**, and **Anatomy and Physiology for Yogic practices**
- Understand Yogic therapies and **modern concept of yoga**, Different mudras during Prayers, Introduction to human body and its systems.
- Define Anatomy and Physiology and importance of yogic practice.
- Understand science of Asanas on various systems, like Respiratory, Digestive, Endocrine, Nervous and Circulatory Systems

Credit: 2

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Theoretical Aspects of Yoga and Philosophy of Yoga** Origin of Yoga and its brief Development, Meaning of Yoga and its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of Meditation and its types and principles, Classification of Yoga/ Types of Yoga, Hatha Yoga, Raja Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Ashtanga Yoga	1	15
Unit-II	**Physical Aspects of Yoga ,Mental Aspects of Yoga Anatomy and Physiology for Yogic practices** Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya, its types and principles. Yogic therapies and modern concept of yoga Meaning and importance of Prayer, Psychology of Mantras, Different mudras during Prayers Introduction to human body and its systems, Definition of Anatomy and Physiology and importance of yogic practice. Respiratory, Digestive, Endocrine, Nervous	1	15

	and Circulatory Systems, Effect of Asanas on various systems		

Reference Books:

1. B.K.S. Iyengar, “Light on Yoga”, Thorsons, 2006 edition
2. Thich Naht Hanh, “Silence”, Rider, 2015
3. Sri Rangarajan Video on “Dinacharya”
4. Sadhguru, “Inner Engineering: A Yogi's Guide to Joy” Penguin Publisher, 2016

Other References:

1. Sri Sri Ravishankar, “Patnajali Yoga Sutras”, Sri Sri Publicaitons Trust, 2012
2. Baba Ramdev Video on “Pranyaama”
3. Dr. Renu Mahatani, “Power of Pranayama”, Jaico, 2017
4. Nicolai Bachman, “the Path of the YOGA SUTRAS” Jaico, 2016
5. Anodea Judith, “Chakra Yoga”, Jaico, 2017.

Hemchandracharya North Gujarat University
PATAN - 384265

Faculty of Science

M.Sc. ELECTRONICS Programme (2yearPG)
(With Research Programme) NEP 2020

With effect from June2026

Curriculum and Credit Frame work For M.Sc. SEM I To M.Sc. SEM IV

As per UGC Guidelines

(According to NATIONAL EDUCATION POLICY (NEP)–2020)

M.Sc. Physics Syllabus for Semester I TO IV

M.Sc. ELECTRONICS (Course Work)

M.Sc. ELECTRONICS (With Research)

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

M.Sc. Electronics: SEMESTER –I 109

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: : **MATHEMATICAL PHYSICS- 1**, **SEMICONDUCTOR PHYSICS AND POWER SUPPLY**

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE101**

(Effective from June 2026 under NEP- 2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
</table>

Course Objectives
• To develop a strong mathematical foundation in **complex variable theory** and its applications to physical problems. • To understand different types of Semiconductor fundamentals, Wave Shaping and power supply.
Course Outcomes After completing this course, students will be able to understand: • Apply **complex analysis technique** such as contour integration, Laurent series, and residue theorem to evaluate definite integrals. • Designing of Amplifiers, filters and power supplies.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples. **Reference Books** M. L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, USA (2005). 2.P. K.Chattopadhyaya,MathematicalPhysics,3rdEd., New Age International Pvt. Ltd., New Delhi (2022).	1	15

	3. G.B.Arfken and H.J.Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier, USA (2005). 4. SatyaPrakash, Mathematical Physics,6thEd.,Sultan Chand & Sons, New Delhi (2020). 5. B.S.Rajput, Mathematical Physics,28thEd.,Pragati Prakashan, Meerut (2015).		
Unit -II	**Semiconductor Physics** The energy band theory of crystals, Insulators, Semiconductors and Metals, Mobility and Conductivity, Electrons and holes in an Intrinsic Semiconductor, Donor and Acceptor impurities, Charge densities, Hall Effect, Conductivity Modulation, Generation and recombination of charges Diffusion, Continuity Equation, Injected Minority carrier Charge, Potential Variation within a graded semiconductor, Energy distribution of electrons in a metal, Fermi-Dirac function, Densities of states, Electron emission from a metal, Carrier concentration in an intrinsic semi, fermi-level, band Structure of an open-circuit PN characteristic, dynamic diffusion capacitance. Schottky barriers, Rectifying contacts, Ohmic contacts, Typical schottky barriers, metal insulator semiconductor diodes: Ideal metal insulator semiconductor (MIS) diode, Surface space charge region, Ideal MIS curves.	1	15
Unit -III	1. **WAVE SHAPING CIRCUIT:** linear wave shaping, the high pass RC circuit, High pass RC circuit as differentiator, the Low pass RC circuit, Low pass circuit as an integrator, Non Linear wave shaping, PN junction diode switching times.	1	15

Unit-IV	Rectifiers(Halfwave, Fullwave and Bridge), Three terminal Voltage regulators, Fixed and Adjustable Voltage Regulators (78XX, LM317), Heat Sink, Dual Power supply (LM320, LM317), Basic Switching Regulator and its characteristics • Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) • Integrated Electronics by Milmann and Halkias • Electronics and radio engineering by M.L.Gupta • OP-AMP and linear Integrated circuits by R.A.Gayakwad,PHI Pub.	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I 102

TYPE OFCOURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SOLID STATE PHYSICS, C-PROGRAMMING,

ELECTRONICS –I & DIGITAL ELECTRONICS

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE102**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY	External Marks (SEE)- 50 Internal Marks (CCE) -50

Course Objectives

- To understand the **electronic structure of solids**, including energy and formation and Fermi surface concepts.
- To introduce **C programming fundamentals** for problem-solving and scientific computation.
- To study the **working principles and applications of operational amplifiers** in analog circuits.
- To provide foundational knowledge of **digital electronics**, including flip-flops, registers, and counters.

Course Outcomes

After completing this course, students will be able to:

- Explain **energy band theory**, Bloch functions, and electron behavior in periodic potentials.
- Write, execute, and debug **basic C programs** using appropriate data types and variables.
- Analyze and design **OP-AMP based circuits** such as amplifiers, integrators, and waveform generators.
- Understand and apply **digital logic circuits** including flip-flops, shift registers, and counters in practical systems.

Syllabus

Unit No.	**Content**	**Credit**	**Lect.Hrs 60**
Unit-I	**Energy Bands and Fermi Surfaces** **Energy Bands:** Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbital's in a band **Reference Books** 1.C.Kittle, Introduction to Solid State Physics, 8thEd., Wiley Eastern Limited, New Delhi (2018).	1	15

	2.J. P. Srivastava, Elements of Solid State Physics,4thEd.,PHIL earning Private Limited, Delhi (2016). 3.C.M.Kachhava, Solid State Physics, Solid State Devices and Electronics, New Age International Publishers, New Delhi (2011).		
Unit-II	**C-Programming** **(a) Overview of C**: History of C (1.1), Importance of C (1.2), Sample Program: Printinga Message(1.3),Basic Structure of C Programs (1.8), Programming Style (1.9), Executing a C Program (1.10). **(b) Constants, Variables & Data Types**: (**Programming in C)** Introduction(2.1),Character Set(2.2),C Tokens (2.3), Keywords and Identifiers (2.4), Constants (2.5), Variables (2.6), Data Types (2.7), Declaration of Variables (2.8), Declaration of Storage Class (2.9), Assigning Values of Variables (2.10), Defining Symbolic Constants (2.11), Declaring a Variable as Constant(2.12),Declaring a Variableas Volatile(2.13), Overflow and Underflow of Data (2.14). **Basic Reference:** *Programming in ANSIC by E.Balaguruswami (THM) (3rd Edition)*	1	15
Unit-III	**The Operational Amplifier & Applications** **OPERATIONAL AMPLIFIER**: Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing –Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator, **Reference Books** 1. K. R. Botkar, Integrated Circuits, 10th Ed., Khanna Publishers, New Delhi (1987). 2.R. Boylested and L. Nashelsky,ElectronicDevicesandCircuitTheory,4thEd. , Longman Higher Education, New Delhi (1987). 3. J. D. Ryder, Electronic Fundamentals and Applications: Integrated and Discrete Systems,5thEd., PHI, New Delhi (1975). 4. A.Mottershead, Electronic Devices and Circuits: An Introduction PHI, New Delhi (1979). 5. K. V. Ramanan, Functional Electronics, Tata McGraw-Hill,NewDelhi(1984).6.R.Gayakwad,	1	15

	OP AMP & Linear Integrated Circuits, 3rdEd.,PHI, New Delhi (1993).		
Unit-IV	**DIGITALELECTRONICS** FLIPFLOP: RS FLIP-FLOPS, D FLIP-FLOPS, JK FLIP-FLOPS, and Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in serial out, serial in parallel out, parallel in serial out, parallel in parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. **Reference Books** A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications,8thEd.,TataMcGraw-Hill Publishing Company Limited, New Delhi (2014). 2. A.Kumar, Fundamentals of DigitalCircuits,4thEd., PHI Private Limited, New Delhi (2016). 3. M.Morris Mano, Digital Logic and Computer Design, PHI Private Limited, New Delhi (2006). 4. A.K.Maini, Digital Electronics Principles, Devices and Applications, 1st Ed., John Wiley & Sons Ltd, England (2007).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. ELECTRONICS: SEMESTER –I 103

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: ELECTRODYNAMICS AND ELECTRONICS -II PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE103**

(Effective from June2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
To study the propagation of electromagnetic waves in matter, including reflection, transmission, and frequency-dependent material response.
To understand the principles and structures of waveguides and resonant cavities For guided wave propagation.
To introduce the operation, biasing, and frequency response of FETamplifiers, including JFETs and MOSFETs.
To analyze the working and performance of power amplifiers under different classes of operation.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
Analyze electromagnetic wave behavior in linear media, including normal and oblique incidence, total internal reflection, and metallic reflection.
Explain and apply concepts of waveguides, resonant cavities, and dielectric guides in microwave and communication systems.
Design and evaluate FET amplifier circuits (common source, common drain, and common gate) for low- and high-frequency applications.
Compare and analyze power amplifier classes (A, B, push-pull, tuned amplifiers) based on efficiency, power dissipation, and performance.</td></tr>
</table>

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Electromagnetic waves in Matter** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B. B., Electromagnetics, Wiley Eastern,(2nded.) 3. E.C.Jordanand K.G.Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15

Unit-II	**POYNTING VECTOR AND THE FLOW OF POWER:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conductor **WAVEGUIDES:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, waveguide of rectangular cross section, co-axial waveguides, resonant cavities, dielectric waveguides, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electro dynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B.B., Electromagnetics, Wiley Eastern, (2nded.) 3. E.C.Jordan and K.G.Balmain, Electromagnetic Waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15
Unit-III	**FETAmplifiers:** FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source a.c. amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source and common drain amplifier common source amplifier at high frequency, common drain amplifier at high frequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad, PHI Pub	1	15
Unit-IV	**Power Amplifier** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers, Class-A power amplifier, and power distribution, Transformer coupled class -A amplifier, Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26PDSCCELE104**

(Effective from June 2026 under NEP-2020)

TYPEOF COURSE	CREDIT	Marks	COURSECODE
Discipline Core Course Practical(PDSC)	2 (Group A) and 2 (Group B)(Total4 Credit)	25 CCE +25 SEE =50 (For Both Group)	**SC2M26PDSCCELE104**
Teaching Hours Teaching Hours per Week:08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT COURSE:- GROUP A

(1) To find Hall co-efficient of Hall Effect
(2) Computer (MS- WORD)
(3) To calculate self-inductance (L) of a given coil using Rayleigh Method
(4) Determination of velocity of Ultrasonic waves in a liquid/solid using Ultrasonic Interferometer
(5) To find wavelength of a monochromatic light using F P Interferometer
(6) Computer Simulation–I(Projectile Motion using MS EXCEL)
(7) Computer Simulation–II(Capacitor charging and discharging using MS EXCEL)
(8) Code conversion(Binary, Octal, Decimal and Hexadecimal)

LABORATORY EXPERIMENT COURSE:- GROUP B

(1) To find the frequency of Transistorized Phase shift Oscillator
(2) To find the frequency of Astable Multivibrator
(3) To obtain frequency response of FET Amplifier
(4) To find Bandwidth of OP-AMP as an Inverting OP-Amp
(5) To find LTP and UTP of Transistorized Schmitt Trigger
(6) To study characteristics of MOSFET
(7) To study characteristics of SCR
(8) Regulated Power Supply(78xx & 79xx).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. ELECTRONICS: SEMESTER -I

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SPECTROSCOPY AND MICROSCOPY

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26MDCELE105**

(Effective from June 2026 under NEP-2020)

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks (SEE)–25 Internal Marks(CCE) -25

Course Objectives

- To understand the **principles and instrumentation of UV–Visibles pectroscopy** And its application in material and chemical analysis.
- To introduce the **fundamental concepts of electron and scanning probe microscopy** techniques.
- To study the **working principles, instrumentation, and sample preparation** Methods for SEM, TEM, STM, and SFM.
- To familiarize students with **applications of spectroscopic and microscopic techniques** in research and industry.

Course Outcomes

After completing this course, students will be able to:

- Explain the **principle, instrumentation, and applications of UV–Visible spectroscopy**, including Beer–Lambert's law and electronic transitions.
- Describe the **operating principles and capabilities of SEM and FESEM**, and compare them with conventional SEM.
- Understand **TEM operation**, resolution limits, imaging modes, and specimen preparation techniques.
- Differentiate between **STM and SFM**, and apply scanning probe microscopy concepts for surface topography and profilometry analysis.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**UV-VIS Spectroscopy** Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing n, a and n electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	1	15
Unit-II	**MICROSCOPY:** **Scanning Electron Microscopy (SEM)** Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM,	1	15

	Advantages over conventional SEM, Applications **Transmission Electron Microscopy (TEM)** Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation **Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)** Introduction, Instrumentation, Topography, Profilometry, Sample Requirements		

Reference Books

1. Scanning Electron Microscopy ,X-Ray Micro analysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams

2. Elementary Organic Spectroscopy, YR SharmaS. Chand.

3. Molecular Structure and Spectroscopy, GAruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG109** COURSE CODE: **SC2M26PMDCELE106**

(Effective from June2026 under NEP-2020)

TYPEOF COURSE	**CREDIT**	**Marks**	**COURSECODE**
Discipline Core Course Practical (PDSC)	2	25 CCE +25 SEE =50	**SC2M26PMDCELE106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE:

(1) Calibration of Magnetic Field

(2) Measurement of Frequency by CRO

(3) DIAC Characteristics

(4) Absorption Co-Efficient of Liquid using Photocell

(5) Calculate Energy band gap and its types of given UV-VIS Spectra

(6) To Find Wave number and Tentative assignment(bonding) of given IR Spectra

(7) Fibreless Optical Communication using LASER

AND/OR

Project Work:

The student needs to submit Project report/Dissertation and can show demonstration of the project.

HEMCHANDRACHARYA NORTHGUJARAT UNIVERSITY,PATAN

M.Sc. ELECTRONICS: SEMESTER -I

TYPEOFCOURSE: VALUE ADDED COURSE (THEORY)

COURSENAME: SCIENCE OF YOGA

PROGRAMME CODE: **SCIPG109** COURSE CODE: **SC2M26VACELE107**

<table>
<tr><td rowspan="2">Total Credits: 02
Teaching Hours per Week:02
Teaching Hours per Semester: 30</td><td rowspan="2">THEORY</td><td>External Marks(SEE)–25</td></tr>
<tr><td>Internal Marks(CCE) -25</td></tr>
<tr><td colspan="3">Course Objectives
To understand
• UpaYoga: Simple preparatory exercises for Suryanamaskar
• Suryanamaskar
• Yoga namaskar
• Few Asanas : Vajrasana, Bhujnagasana, Sarvangasana
• Pranayama : Bastrika, Anulom Vilom, Bramari, Udgita and Pranayam
• Mudras
• A Few Prayers: Gayatri Mantra, Gita Slokas and Shanti mantras</td></tr>
<tr><td colspan="3">Course Outcomes
After completing this course, students will be able to:
• Explain the Theoretical Aspects of Yoga and Philosophy of Yoga , including Yoga as a Science of Art and Classification of Yoga.
• Describe the Physical Aspects of Yoga ,Mental Aspects of Yoga, and Anatomy and Physiology for Yogic practices
• Understand Yogic therapies and modern concept of yoga, Different mudras during Prayers, Introduction to human body and its systems.
• Define Anatomy and Physiology and importance of yogic practice.
• Understand science of Asanas on various systems, like Respiratory, Digestive, Endocrine, Nervous and Circulatory Systems</td></tr>
</table>

Credit: 2

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Theoretical Aspects of Yoga and Philosophy of Yoga** Origin of Yoga and its brief Development, Meaning of Yoga and its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of Meditation and its types and principles, Classification of Yoga/ Types of Yoga, Hatha Yoga, Raja Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Ashtanga Yoga	1	15
Unit-II	**Physical Aspects of Yoga ,Mental Aspects of Yoga Anatomy and Physiology for Yogic practices** Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya, its types and principles. Yogic therapies and modern concept of yoga Meaning and importance of Prayer, Psychology of Mantras, Different mudras during Prayers Introduction to human body and its systems, Definition of Anatomy and Physiology and importance of yogic practice. Respiratory, Digestive, Endocrine, Nervous	1	15

	and Circulatory Systems, Effect of Asanas on various systems		

Reference Books:

1. B.K.S. Iyengar, “Light on Yoga”, Thorsons, 2006 edition
2. Thich Naht Hanh, “Silence”, Rider, 2015
3. Sri Rangarajan Video on “Dinacharya”
4. Sadhguru, “Inner Engineering: A Yogi's Guide to Joy” Penguin Publisher, 2016

Other References:

1. Sri Sri Ravishankar, “Patnajali Yoga Sutras”, Sri Sri Publicaitons Trust, 2012
2. Baba Ramdev Video on “Pranyaama”
3. Dr. Renu Mahatani, “Power of Pranayama”, Jaico, 2017
4. Nicolai Bachman, “the Path of the YOGA SUTRAS” Jaico, 2016
5. Anodea Judith, “Chakra Yoga”, Jaico, 2017.

Hemchandracharya North Gujarat University
PATAN - 384265

Faculty of Science

M.Sc. Electronics Programme (2yearPG)
(Only Research Programme) NEP 2020

With effect from June2026

Curriculum and Credit Frame work For M.Sc. SEM I To M.Sc. SEM IV

As per UGC Guidelines

(According to NATIONAL EDUCATION POLICY (NEP)–2020)

M.Sc. Electronics Syllabus for Semester I TO IV

M.Sc. Electronics (Course Work)

M.Sc. Electronics (Only Research)

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

M.Sc. Electronics: SEMESTER –I 109

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: : **MATHEMATICAL PHYSICS- 1**, **SEMICONDUCTOR PHYSICS AND POWER SUPPLY**

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE101**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week:04 Teaching Hours per Semester: 60	THEORY	External Marks(SEE)- 50 Internal Marks(CCE) -50

Course Objectives

- To develop a strong mathematical foundation in **complex variable theory** and its applications to physical problems.
- To understand different types of Semiconductor fundamentals, Wave Shaping and power supply.

Course Outcomes

After completing this course, students will be able to understand:

- Apply **complex analysis technique** such as contour integration, Laurent series, and residue theorem to evaluate definite integrals.
- Designing of Amplifiers, filters and power supplies.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples. **Reference Books** M. L. Boas, Mathematical Methods in the Physical Sciences, 3rd Ed., Wiley, USA (2005). 2.P. K.Chattopadhyaya,MathematicalPhysics,3rdEd., New Age International Pvt. Ltd., New Delhi (2022).	1	15

	3. G.B.Arfken and H.J.Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier, USA (2005). 4. SatyaPrakash, Mathematical Physics,6thEd.,Sultan Chand & Sons, New Delhi (2020). 5. B.S.Rajput, Mathematical Physics,28thEd.,Pragati Prakashan, Meerut (2015).		
Unit -II	**Semiconductor Physics** The energy band theory of crystals, Insulators, Semiconductors and Metals, Mobility and Conductivity, Electrons and holes in an Intrinsic Semiconductor, Donor and Acceptor impurities, Charge densities, Hall Effect, Conductivity Modulation, Generation and recombination of charges Diffusion, Continuity Equation, Injected Minority carrier Charge, Potential Variation within a graded semiconductor, Energy distribution of electrons in a metal, Fermi-Dirac function, Densities of states, Electron emission from a metal, Carrier concentration in an intrinsic semi, fermi-level, band Structure of an open-circuit PN characteristic, dynamic diffusion capacitance. Schottky barriers, Rectifying contacts, Ohmic contacts, Typical schottky barriers, metal insulator semiconductor diodes: Ideal metal insulator semiconductor (MIS) diode, Surface space charge region, Ideal MIS curves.	1	15
Unit -III	**WAVE SHAPING CIRCUIT:** linear wave shaping, the high pass RC circuit, High pass RC circuit as differentiator, the Low pass RC circuit, Low pass circuit as an integrator, Non Linear wave shaping, PN junction diode switching times.	1	15

Unit-IV	Rectifiers(Halfwave, Fullwave and Bridge), Three terminal Voltage regulators, Fixed and Adjustable Voltage Regulators (78XX, LM317), Heat Sink, Dual Power supply (LM320, LM317), Basic Switching Regulator and its characteristics Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) Integrated Electronics by Milmann and Halkias Electronics and radio engineering by M.L.Gupta OP-AMP and linear Integrated circuits by R.A.Gayakwad,PHI Pub.	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I 102

TYPE OFCOURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SOLID STATE PHYSICS, C-PROGRAMMING, ELECTRONICS –I & DIGITAL ELECTRONICS

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE102**

(Effective from June 2026 under NEP- 2020)

Total Credits: 04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY	External Marks (SEE)- 50 Internal Marks (CCE) -50

Course Objectives

- To understand the **electronic structure of solids**, including energy and formation and Fermi surface concepts.
- To introduce **C programming fundamentals** for problem-solving and scientific computation.
- To study the **working principles and applications of operational amplifiers** in analog circuits.
- To provide foundational knowledge of **digital electronics**, including flip-flops, registers, and counters.

Course Outcomes

After completing this course, students will be able to:

- Explain **energy band theory**, Bloch functions, and electron behavior in periodic potentials.
- Write, execute, and debug **basic C programs** using appropriate data types and variables.
- Analyze and design **OP-AMP based circuits** such as amplifiers, integrators, and waveform generators.
- Understand and apply **digital logic circuits** including flip-flops, shift registers, and counters in practical systems.

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**Energy Bands and Fermi Surfaces** **Energy Bands:** Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbital's in a band **Reference Books** 1.C.Kittle, Introduction to Solid State Physics, 8thEd., Wiley Eastern Limited, New Delhi (2018).	1	15

	2.J. P. Srivastava, Elements of Solid State Physics,4thEd.,PHIL earning Private Limited, Delhi (2016). 3.C.M.Kachhava, Solid State Physics, Solid State Devices and Electronics, New Age International Publishers, New Delhi (2011).		
Unit-II	**C-Programming** **(a) Overview of C**: History of C (1.1), Importance of C (1.2), Sample Program: Printinga Message(1.3),Basic Structure of C Programs (1.8), Programming Style (1.9), Executing a C Program (1.10). **(b) Constants, Variables & Data Types**: (**Programming in C)** Introduction(2.1),Character Set(2.2),C Tokens (2.3), Keywords and Identifiers (2.4), Constants (2.5), Variables (2.6), Data Types (2.7), Declaration of Variables (2.8), Declaration of Storage Class (2.9), Assigning Values of Variables (2.10), Defining Symbolic Constants (2.11), Declaring a Variable as Constant(2.12),Declaring a Variableas Volatile(2.13), Overflow and Underflow of Data (2.14). **Basic Reference:** *Programming in ANSIC by E.Balaguruswami (THM) (3rd Edition)*	1	15
Unit-III	**The Operational Amplifier & Applications** **OPERATIONAL AMPLIFIER**: Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing –Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator, **Reference Books** 1. K. R. Botkar, Integrated Circuits, 10th Ed., Khanna Publishers, New Delhi (1987). 2.R. Boylested and L. Nashelsky,ElectronicDevicesandCircuitTheory,4thEd. , Longman Higher Education, New Delhi (1987). 3. J. D. Ryder, Electronic Fundamentals and Applications: Integrated and Discrete Systems,5thEd., PHI, New Delhi (1975). 4. A.Mottershead, Electronic Devices and Circuits: An Introduction PHI, New Delhi (1979). 5. K. V. Ramanan, Functional Electronics, Tata McGraw-Hill,NewDelhi(1984).6.R.Gayakwad,	1	15

	OP AMP & Linear Integrated Circuits, 3rdEd.,PHI, New Delhi (1993).		
Unit-IV	**DIGITALELECTRONICS** FLIPFLOP: RS FLIP-FLOPS, D FLIP-FLOPS, JK FLIP-FLOPS, and Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in serial out, serial in parallel out, parallel in serial out, parallel in parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. **Reference Books** A. P. Malvino, D. P. Leach and G. Saha, Digital Principles and Applications,8thEd.,TataMcGraw-Hill Publishing Company Limited, New Delhi (2014). 2. A.Kumar, Fundamentals of DigitalCircuits,4thEd., PHI Private Limited, New Delhi (2016). 3. M.Morris Mano, Digital Logic and Computer Design, PHI Private Limited, New Delhi (2006). 4. A.K.Maini, Digital Electronics Principles, Devices and Applications, 1st Ed., John Wiley & Sons Ltd, England (2007).	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. ELECTRONICS: SEMESTER –I 103

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: ELECTRODYNAMICS AND ELECTRONICS -II PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26DSCCELE103**

(Effective from June2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 04
Teaching Hours per Week:04
Teaching Hours per Semester: 60</td><td rowspan="2">THEORY</td><td>External Marks(SEE)- 50</td></tr>
<tr><td>Internal Marks(CCE) -50</td></tr>
<tr><td colspan="3">Course Objectives
• To study the propagation of electromagnetic waves in matter, including reflection, transmission, and frequency-dependent material response.
• To understand the principles and structures of waveguides and resonant cavities For guided wave propagation.
• To introduce the operation, biasing, and frequency response of FETamplifiers, including JFETs and MOSFETs.
• To analyze the working and performance of power amplifiers under different classes of operation.</td></tr>
<tr><td colspan="3">Course Outcomes
After successful completion of this course, students will be able to:
• Analyze electromagnetic wave behavior in linear media, including normal and oblique incidence, total internal reflection, and metallic reflection.
• Explain and apply concepts of waveguides, resonant cavities, and dielectric guides in microwave and communication systems.
• Design and evaluate FET amplifier circuits (common source, common drain, and common gate) for low- and high-frequency applications.
• Compare and analyze power amplifier classes (A, B, push-pull, tuned amplifiers) based on efficiency, power dissipation, and performance.</td></tr>
</table>

Syllabus

Unit No.	**Content**	**Credit**	**Lect.Hrs 60**
Unit-I	**Electromagnetic waves in Matter** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B. B., Electromagnetics, Wiley Eastern,(2nded.) 3. E.C.Jordanand K.G.Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15

Unit-II	**POYNTING VECTOR AND THE FLOW OF POWER:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conductor **WAVEGUIDES:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, waveguide of rectangular cross section, co-axial waveguides, resonant cavities, dielectric waveguides, Illustrative examples. **Reference Books:** 1. Griffiths, Introduction to electro dynamics, Prentice Hall India Ltd. (2nd ed.) 2. Laud B.B., Electromagnetics, Wiley Eastern, (2nded.) 3. E.C.Jordan and K.G.Balmain, Electromagnetic Waves and radiating systems, Prentice Hall of India, New Delhi, 1976	1	15
Unit-III	**FETAmplifiers:** FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source a.c. amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source and common drain amplifier common source amplifier at high frequency, common drain amplifier at high frequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta 4. OP-AMP and linear Integrated circuits by R.A.Gayakwad, PHI Pub	1	15
Unit-IV	**Power Amplifier** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers, Class-A power amplifier, and power distribution, Transformer coupled class -A amplifier, Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier. **Reference Book:** 1. Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic) 2. Integrated Electronics by Milmann and Halkias 3. Electronics and radio engineering by M.L.Gupta	1	15

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26PDSCCELE104**

(Effective from June 2026 under NEP-2020)

TYPEOF COURSE	CREDIT	Marks	COURSECODE
Discipline Core Course Practical(PDSC)	2 (Group A) and 2 (Group B)(Total4 Credit)	25 CCE +25 SEE =50 (For Both Group)	**SC2M26PDSCCELE104**
Teaching Hours Teaching Hours per Week:08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENT COURSE:- GROUP A

(1) To find Hall co-efficient of Hall Effect
(2) Computer (MS- WORD)
(3) To calculate self-inductance (L) of a given coil using Rayleigh Method
(4) Determination of velocity of Ultrasonic waves in a liquid/solid using Ultrasonic Interferometer
(5) To find wavelength of a monochromatic light using F P Interferometer
(6) Computer Simulation–I(Projectile Motion using MS EXCEL)
(7) Computer Simulation–II(Capacitor charging and discharging using MS EXCEL)
(8) Code conversion(Binary, Octal, Decimal and Hexadecimal)

LABORATORY EXPERIMENT COURSE:- GROUP B

(1) To find the frequency of Transistorized Phase shift Oscillator
(2) To find the frequency of Astable Multivibrator
(3) To obtain frequency response of FET Amplifier
(4) To find Bandwidth of OP-AMP as an Inverting OP-Amp
(5) To find LTP and UTP of Transistorized Schmitt Trigger
(6) To study characteristics of MOSFET
(7) To study characteristics of SCR
(8) Regulated Power Supply(78xx & 79xx).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M. Sc. ELECTRONICS: SEMESTER -I

TYPE OF COURSE: DISCIPLINE SPECIFIC COURSE (THEORY)

COURSE NAME: SPECTROSCOPY AND MICROSCOPY

PROGRAMME CODE:**SCIPG109** COURSE CODE: **SC2M26MDCELE105**

(Effective from June 2026 under NEP-2020)

<table>
<tr><td rowspan="2">Total Credits: 02
Teaching Hours per Week:02
Teaching Hours per Semester: 30</td><td rowspan="2">THEORY</td><td>External Marks (SEE)–25</td></tr>
<tr><td>Internal Marks(CCE) -25</td></tr>
<tr><td colspan="3">Course Objectives
To understand the principles and instrumentation of UV–Visibles pectroscopy And its application in material and chemical analysis.
To introduce the fundamental concepts of electron and scanning probe microscopy techniques.
To study the working principles, instrumentation, and sample preparation Methods for SEM, TEM, STM, and SFM.
To familiarize students with applications of spectroscopic and microscopic techniques in research and industry.</td></tr>
<tr><td colspan="3">Course Outcomes
After completing this course, students will be able to:
Explain the principle, instrumentation, and applications of UV–Visible spectroscopy, including Beer–Lambert's law and electronic transitions.
Describe the operating principles and capabilities of SEM and FESEM, and compare them with conventional SEM.
Understand TEM operation, resolution limits, imaging modes, and specimen preparation techniques.
Differentiate between STM and SFM, and apply scanning probe microscopy concepts for surface topography and profilometry analysis.</td></tr>
</table>

Syllabus

Unit No.	Content	Credit	Lect.Hrs 60
Unit-I	**UV-VIS Spectroscopy** Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing n, a and n electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	1	15
Unit-II	**MICROSCOPY:** **Scanning Electron Microscopy (SEM)** Physical Basis and Primary Modes of Operation, Instrumentation, Sample Requirements, FESEM,	1	15

	Advantages over conventional SEM, Applications **Transmission Electron Microscopy (TEM)** Basic Principle, Resolution, Sensitivity, TEM Operation, Image Mode, Specimen Preparation **Scanning Tunneling Microscopy (STM) and Scanning Force Microscopy (SFM)** Introduction, Instrumentation, Topography, Profilometry, Sample Requirements		

Reference Books

1. Scanning Electron Microscopy ,X-Ray Micro analysis, and Analytical Electron microscopy, A Laboratory Workbook, Patrick Echlin, Alton D. Romig Jr., Gwyn Williams

2. Elementary Organic Spectroscopy, YR SharmaS. Chand.

3. Molecular Structure and Spectroscopy, GAruldhas PHI publisher.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

M.Sc. ELECTRONICS: SEMESTER –I (PRACTICAL COURSE)

TYPE OF COURSE: DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: **SCIPG109** COURSE CODE: **SC2M26PMDCELE106**

(Effective from June2026 under NEP-2020)

TYPEOF COURSE	**CREDIT**	**Marks**	**COURSECODE**
Discipline Core Course Practical (PDSC)	2	25 CCE +25 SEE =50	**SC2M26PMDCELE106**
Teaching Hours Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

LABORATORY EXPERIMENTS COURSE:

(1) Calibration of Magnetic Field

(2) Measurement of Frequency by CRO

(3) DIAC Characteristics

(4) Absorption Co-Efficient of Liquid using Photocell

(5) Calculate Energy band gap and its types of given UV-VIS Spectra

(6) To Find Wave number and Tentative assignment(bonding) of given IR Spectra

(7) Fibreless Optical Communication using LASER

AND/OR

Project Work:

The student needs to submit Project report/Dissertation and can show demonstration of the project.

HEMCHANDRACHARYA NORTHGUJARAT UNIVERSITY,PATAN

M.Sc. ELECTRONICS: SEMESTER -I

TYPEOFCOURSE: VALUE ADDED COURSE (THEORY)

COURSENAME: SCIENCE OF YOGA

PROGRAMME CODE: **SCIPG109** COURSE CODE: **SC2M26VACELE107**

Total Credits: 02 Teaching Hours per Week:02 Teaching Hours per Semester: 30	THEORY	External Marks(SEE)–25 Internal Marks(CCE) -25

Course Objectives

To understand

- UpaYoga: Simple preparatory exercises for Suryanamaskar
- Suryanamaskar
- Yoga namaskar
- Few Asanas : Vajrasana, Bhujnagasana, Sarvangasana
- Pranayama : Bastrika, Anulom Vilom, Bramari, Udgita and Pranayam
- Mudras
- A Few Prayers: Gayatri Mantra, Gita Slokas and Shanti mantras

Course Outcomes

After completing this course, students will be able to:

1. Explain the **Theoretical Aspects of Yoga and Philosophy of Yoga** , including Yoga as a Science of Art and Classification of Yoga.
- Describe the **Physical Aspects of Yoga ,Mental Aspects of Yoga**, and **Anatomy and Physiology for Yogic practices**
- Understand Yogic therapies and **modern concept of yoga**, Different mudras during Prayers, Introduction to human body and its systems.
- Define Anatomy and Physiology and importance of yogic practice.
- Understand science of Asanas on various systems, like Respiratory, Digestive, Endocrine, Nervous and Circulatory Systems

Credit: 2

Unit No.	Content	Credit	Lect. Hrs 30
Unit-I	**Theoretical Aspects of Yoga and Philosophy of Yoga** Origin of Yoga and its brief Development, Meaning of Yoga and its importance, Yoga as a Science of Art (Yoga Philosophy), Meaning of Meditation and its types and principles, Classification of Yoga/ Types of Yoga, Hatha Yoga, Raja Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Ashtanga Yoga	1	15
Unit-II	**Physical Aspects of Yoga ,Mental Aspects of Yoga Anatomy and Physiology for Yogic practices** Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya, its types and principles. Yogic therapies and modern concept of yoga Meaning and importance of Prayer, Psychology of Mantras, Different mudras during Prayers Introduction to human body and its systems, Definition of Anatomy and Physiology and importance of yogic practice. Respiratory, Digestive, Endocrine, Nervous	1	15

	and Circulatory Systems, Effect of Asanas on various systems		

Reference Books:

1. B.K.S. Iyengar, “Light on Yoga”, Thorsons, 2006 edition
2. Thich Naht Hanh, “Silence”, Rider, 2015
3. Sri Rangarajan Video on “Dinacharya”
4. Sadhguru, “Inner Engineering: A Yogi's Guide to Joy” Penguin Publisher, 2016

Other References:

1. Sri Sri Ravishankar, “Patnajali Yoga Sutras”, Sri Sri Publicaitons Trust, 2012
2. Baba Ramdev Video on “Pranyaama”
3. Dr. Renu Mahatani, “Power of Pranayama”, Jaico, 2017
4. Nicolai Bachman, “the Path of the YOGA SUTRAS” Jaico, 2016
5. Anodea Judith, “Chakra Yoga”, Jaico, 2017.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

PATAN-384265

NAAC "B" (2.21) State University

FACULTYOFSCIENCE

M.Sc. BOTANY (2 YEAR)

(ONLY COURSE WORK PROGRAMME)

SCIPG103

Semesters: I TO IV

MASTER DEGREE SYLLABUS

Curriculum as per UGC Guideline

Framed according to National Education Policy (NEP) - 2020

With effect from June – 2026 (and thereafter)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

PATAN-384265

NAAC "B" (2.21) State University

M.Sc. BOTANY (2 YEAR)

(ONLY COURSE WORK PROGRAMME)

SCIPG103

Semesters: I TO IV

MASTER DEGREE SYLLABUS

With effect from June – 2026 (and thereafter)

FACULTYOFSCIENCE

Subject: BOTANY

Total Pages: 01 to 72

Submitted on

Date: 9th April 2026(Wednesday)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC "B" (2.21) State University

PATAN-384265

BOARD OF STUDIES (BOS) IN BOTANY

References: No. AK/S.Mn.-2/BOS/4400/2025 Dt. 16/09/2025.
No. AK/S.Mn.-2/BOS/5585/2025 Dt. 10/11/2025.

Statute	Name of BoS Members	Designation
25(2)(b)(i)	Prof. Ilaben Patel	MEMBER
	Dr. Ashish Patel	
25(2)(b) (ii)	Dr. Charuben V. Jha	
	Dr. Sanjay D. Vediya	
25(2)(b) (iii)	Dr. N. B. Patel	
	Dr. Ashok H. Patel	
25(2)(c)	Dr. Narendrakumar K. Patel	
	Pri. Dr. Yogesh B. Dabgar	CHAIRMAN
	Dr. Hamirbhai M. Ant	MEMBER
25(2)(d) (ii)	Prof. Suhas Vyas	CO-OPT MEMBER
25(2) (d) (iii)(A)	Dr. H. A. Solanki	
25(2) (d) (iii)(B)	Dr. B. A. Jadeja	
25(2) (d) (iii)(C)	Dr. Jigna Tank	
25(2) (d) (iii)(D)	Dr. T. G. Gohil	
25(2) (d) (iii)(E)	Kashish S.Patel	
	Ami B.Makvana	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
M.Sc. ONLY COURSE WORK PROGRAMME 88 credits
FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP- 2020) w.e.f.June-2026
General Pattern/Schemeofstudycomponentsalongwithcreditsfor Sciencefaculty.
Semester: I & II

MASTER DEGREE COURSE (ONLY COURSE WORK PROGRAMME) SCIPG103									
Part/Class	Course Type	Subject code	Study Components	Hrs/ Week	Examination Marks			Credits	Exam Duration (Hours)
					CCE	SEE	Total		
M.Sc. Semester -I		SEMESTER-I							
	DSCC1	SC2M26 DSCCBOT101	Plant Diversity-I	4	50	50	100	4	02:30
	DSCC2	SC2M26 DSCCBOT 102	Plant Taxonomy	4	50	50	100	4	
	DSCC3	SC2M26 DSCCBOT 103	Cell Biology	4	50	50	100	4	
	DSCC4	SC2M26PDSCCBOT 104	PRACTICAL Plant Diversity-I: Plant Taxonomy, Cell Biology	8	50	50	100	4	06:00
	MDC1	SC2M26 MDC BOT 105	Genetics	2	25	25	50	2	02:00
	MDC2	SC2M26 PMDCBOT106	PRACTICAL Genetics	4	25	25	50	2	03:00
	VAC	SC2M26 VACBOT107	Bio fertilizer Technology	2	25	25	50	2	02:00
		Total		28	275	275	550	22	
SEMESTER II									
M.Sc. Semester -II	DSCC1	SC2M26 DSCCBOT201	Plant Diversity-II	4	50	50	100	4	02:30
	DSCC2	SC2M26 DSCCBOT202	Plant Anatomy and Reproduction	4	50	50	100	4	
	DSCC3	SC2M26 DSCCBOT203	Plant Ecology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCCBOT204	PRACTICAL Plant Diversity-II: Plant Anatomy and Reproduction, Plant Ecology	8	50	50	100	4	06:00
	MDC	SC2M26MDC BOT205	Bio Chemistry	2	25	25	50	2	02:00
	SEC	SC2M26 PSECBOT206	PRACTICAL Bio Chemistry	4	25	25	50	2	03:00
	VOC	SC2M26VOC BOT207	Air Pollution and Climate Change	2	25	25	50	2	02:00
	SWAYAM	SWAYAM	SWAYAM- Select from Portal						
		Total		28	275	275	550	22	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
M.Sc. ONLY COURSE WORK PROGRAMME 88 credits
FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP- 2020) w.e.f.June-2026
General Pattern/Schemeofstudycomponentsalongwithcreditsfor Sciencefaculty.
Semester: III & IV

Part/Class	Course Type	Subjectcode	Study Components	Hrs/ Week	Examination Marks CCE	SEE	Total	Credits	Exam Duration (Hours)
MASTER DEGREE COURSE (ONLY COURSE WORK PROGRAMME) SCIPG103									
M.Sc. Semester -III	**SEMESTER-III**								
	DSCC1	SC2M26DSCCBOT301	Plant Diversity-III	4	50	50	100	4	**02:30**
	DSCC2	SC2M26DSCCBOT302	Molecular Biology of Plants	4	50	50	100	4	
	DSCC3	SC2M26DSCCBOT303	Plant Physiology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCCBOT304	**PRACTICAL** Plant Diversity-III , Molecular Biology of Plants&Plant Physiology	8	50	50	100	4	**06:00**
	DSEC1	SC2M26DSECBOT305	Biodiversity conservation	2	25	25	50	2	**02:00**
	DSEC2	SC2M26 PDSECBOT306	**PRACTICAL** Biodiversity conservation	4	25	25	50	2	**03:00**
	DSEC3	SC2M26DSECBOT307	Herbal Medicine	2	25	25	50	2	**02:00**
		Total		**28**	**275**	**275**	**550**	**22**	
M.Sc. Semester -IV	**SEMESTER-IV**								
	DSCC1	SC2M26DSCCBOT401	Plant Biotechnology	4	50	50	100	4	**02:30**
	DSCC2	SC2M26DSCCBOT402	Ethnobotany, Mushrooms and Mycorrhiza	4	50	50	100	4	
	DSCC3	SC2M26DSCCBOT403	Horticulture and Plant Breeding	4	50	50	100	4	
	DSCC4	SC2M26 PDSCCBOT404	**PRACTICAL** Plant Biotechnology, Ethnobotany, Mushrooms and Mycorrhiza &Horticulture and Plant Breeding	8	50	50	100	4	**06:00**
	DSEC1	SC2M26DSECBOT405	Research methodology & Biostatistics,	2	25	25	50	2	**02:00**
	DSEC2	SC2M26 PDSECBOT406	**PRACTICAL** Research methodology & Biostatistics	4	25	25	50	2	**03:00**
	DSEC3	SC2M26DSECBOT407	IPR and Biosafety	2	25	25	50	2	**02:00**
		Total		**28**	**275**	**275**	**550**	**22**	

DETAILED SYLLABUS OF TWO-YEAR PG ONLY COURSE WORK PROGRAM IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

DISCIPLINE SPECIFIC CORE COURSE – DSCC1

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	Credits	Lectures	THEORY	
						CCE	SEE
Master Degree Course	*M.Sc. I*	*SC2M26 DSCC BOT101*	*PLANT DIVERSITY - I*	4	T=60hrs	*50 MARKS*	*50 MARKS*

Course outcomes:	***Programme specific Learning and Course Outcomes:*** On completion of this course, the students will be able to: • Explain the structural and functional diversity of microorganisms including viruses, bacteria, and fungi, along with their modes of reproduction and genetic recombination. • Classify major groups of algae and fungi based on morphological, physiological, and reproductive characteristics. • Analyze microbial interactions and evaluate their applications in agriculture, medicine, food industry, and environmental management. • Describe the diversity, distribution, and ecological significance of algal groups with reference to their pigments, storage products, and thallus organization. • Interpret the life cycles and economic importance of fungi, including their roles in industry, medicine, and as biocontrol agents. • Identify plant diseases based on symptoms, causative agents, and modes of transmission. • Explain disease cycles, dissemination mechanisms, and plant defense strategies against pathogens. • Recommend appropriate control measures for major plant diseases caused by viral, bacterial, and fungal pathogens. **Pedagogy:** Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

THEORY UNIT	*TOPIC*	*NO. OF LECTURES* (60hrs)
Unit 1	**Introduction and Application of Microbiology** • **Viruses:** Types of Viruses (on the basis of Genome), Viroid and Prions. Multiplication of λ phage lytic and lysogenic cycle. • **Bacteria:** Classification based on staining. Ultra structure of bacteria. • **Genetic recombination in bacteria** - conjugation, transformation and transduction. • **Microbial interactions in ecosystems**, Applications of microbes in	15

	agriculture, food and medicine. Microbes waste management and as biocontrol agents.	

Unit 2	**Introduction to Phycology**
	• Brief introduction to the modern classification by Lee (2016) [up to class].
	• Distribution, habitat diversity, range of thallus structure, pigment composition and photosynthetic end product in various groups of algae.
	• Salient features and thallus structure of algae in the following groups with special reference to the type(s) mentioned:
	    • Chlorophyta- Ulvophyceae – *Ulva*
	    • *Chrysophyta- Bacillariophyceae - Diatoms*
	    • Phaeophyta-Dictyotales- *Dictyota*
	    • Rhodophyceae - *Polysiphonia*
	• Application of algae in Environment and Industries..
		15

Unit 3	**MYCOLOGY**
	• Cellular Organization (Unicellular and Multicellular), Nutrition in fungi.
	• Reproduction in Fungi, Heterothallism.
	• General account of:
	    • Zygomycotina (*Mucor*)
	    • Ascomycotina (*Aspergillus*)
	    • Basidiomycotina (*Polyporus*)
	    • Deuteromycotina (*Colletotrichum*).
	• Economic Importance of Fungi: In Industry, Medicine and bio-control agent
		15

Unit 4	**PATHOLOGY** • **Plant Pathology:** Classification of plant diseases (on the basis of host and origin), General Symptoms of plant diseases. • **Dissemination of plant diseases** (Direct and Indirect). Defense mechanism (Morphological and Bio-Chemical). • **Plant pathogens:** Symptoms, Diseases cycle, Control measures: Viral (Potato leaf roll) and Bacterial (Bacterial blight of paddy) • **Plant pathogens:** Symptoms, Diseases cycle, Control measures:	**15**

	Fungal (Tikka disease in Groundnut and Powdery mildew of Cucurbits).	

Suggested Readings:

1. Adetunji, A. T., et al. (2023). *Next generation algae. Vol. I: Application in agriculture, food and environment*. John Wiley & Sons, Beverley, USA.
2. Campbell, R. (1987). *Plant microbiology*. ELBS Edward Arnold, London.
3. Dube, H. C. (2008). *Fungi, bacteria and viruses*. Agrobios, India.
4. Fritsch, F. E. (1955). *The structure and reproduction of algae* (Vols. I–II). Cambridge University Press, UK.
5. Bold, H. C., & Wynne M. J. (1978). *Introduction to algae: Structure and reproduction*. Prentice Hall, USA.
6. Kim, S. K. (2011). *Marine medicinal foods: Implications and applications of micro and macroalgae*. Academic Press, New York.
7. Moheimani,N.R.,McHenry,M.P.,deBoer,K.,&Bahri,P.A.(2015).*Biomassandbiofuels from microalgae*.SpringerInternationalPublishing,Switzerland.
8. Pelczar,M.J.,Chan,E.C.S.,&Krieg,N.R.(1993).*Microbiology*(Indianed.).TataMcGraw-Hill,New Delhi.
9. Sahoo,D.,&Seckbach,J.(2015).*Thealgaeworld*.Springer,Dordrecht,Heidelberg,NewYork.
10. Sharma, O. P. (2011).*Algae*. TataMcGraw-Hill,NewDelhi.
11. Smith,G.M.(1955).*Cryptogamicbotany:Vol.I–Algaeandfungi*.TataMcGraw-Hill, NewYork.
12. Sharma, P. D. (2011) Microbiology. Rastogi Publication. Meerut.
13. Pelczar M. J, Chan E. C. Sand Krieg N. R. (2004) Microbiology, Tata McGraw – Hall Publishing Company Ltd. NewDelhi.
14. Hait G; Bhattacharya K and Ghosh A. K. (2008) A Taxt Book of Botany,Vol-I, New Central Book Agency (P) Ltd. Kolkata.
15. SinghV; Pande P. Cand Jain D. K. (2008-09) A Taxt Book of Botany, rastogi Publication,Meerut.
16. Barsanti L, Gualtieri P (2006) Algae: Anatomy, Biochemistry and Biotechnology, CRC Press,Taylor and Francis, Boca Raton.
17. Bold H C, Wynne M J (1985) Introduction to the Algae, 2nd edition, Prentice-HallInc, NewJersey.
18. Kumar H D (1999) Introductory Phycology, 2nd edition, Affiliated East-West Press Pvt. Ltd.New Delhi
19. Fritsch F E (1935) The Structure and Reproduction of the Algae, Vol I, Cambridge University Press, Cambridge.
20. Fritsch F E (1945) The Structure and Reproduction of the Algae, Vol II, Cambridge University Press, Cambridge.
21. Lee R E (2008) Phycology, 4th edition, Cambridge University Press, Cambridge.
22. South G R, Whittick A (1998) Introduction to Phycology, Blackwell Scientific Publication, London.
23. Webster John (1980) Introduction to fungi, Cambridge University Press, Cambridge.
24. Alexopoulos C J, Mims C W, Blackwell M (1996) Introductory Mycology, John Wiley and Sons, Inc, NewYork.

25. Carlile M J, Watkinson S C, Booday G W (2001) The Fungi, Academic Press, Cambidge.
26. Maheshwari R (2012) Fungi: Experimental Methods in Biology, CRC Press, Boca Raton, Florida.
27. Deacon J W, Blackwell M (1997) Introduction to Modern Mycology, Oxford.
28. Webster J, Roland W S (2007) Introduction to Fungi, Cambridge University Press, Cambridge
29. Rangaswamy, G and Mahadevan, A (1999) Diseases of crop plants in India (4th edn) Prentice Hall of Indian Pvt. New Delhi.
30. Pandey B. P. (2006) Plant Pathology-Pathogen and Plant Diseases. S. Chand & Co. Ltd. New Delhi.
31. Mehrotra R. S. (1991) Plant Pathology, Tata McGraw-Hill Publishing Co. Pvt. Ltd. New Delhi.
32. Agrios George N. (2004) Plant Pathology, Academic Press, Reed Elsevier India Pvt.
33. Ltd. New Delhi.
34. Sharma P. D. (2003) Microbiology and Plant Pathology, Rastogi Publications, Meerut.

DETAILED SYLLABUS OF TWO-YEAR PG ONLY COURSE WORK PROGRAM IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

DISCIPLINE SPECIFIC CORE - DSCC2							
COURSE	***SEMESTER***	***COURSE CODE***	***COURSE TITLE***	***Credits***	***Lectures***	***THEORY***	
						CCE	***SEE***
Master Degree Course	***M.Sc. I***	***SC2M26 DSCC BOT 102***	**PLANT TAXONOMY**	**4T**	**T=60hrs**	***50 MARKS***	***50 MARKS***

Course outcomes:	***Programme specific Learning and Course Outcomes:*** On completion of the course, the students will be able to: • Explain the principles of taxonomy, taxonomic hierarchy, and categories used in plant classification. • Describe the origin and evolution of angiosperms and understand herbarium techniques and botanical gardens. • Apply rules of plant nomenclature (ICBN) and compare major classification systems. • Analyze taxonomic characters derived from morphology, genetics, and cytology. • Use taxonomic tools, databases, and regional flora for plant identification. • Identify important plant families and explain their distribution, characteristics, and economic importance. **Pedagogy:** Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.	
THEORY UNIT	***TOPIC***	***NO. OF LECTURES*** **(60hrs)**
Unit 1	• Principles of taxonomy, Aims of taxonomy, Taxonomic hierarchy. • Major categories: Families and other categories; Minor categories: Genus and Species. • Origin of Angiosperms. • Herbarium methodology, Important Herbaria and Botanical gardens (India and Global), Importance of Herbaria and Botanical gardens.	**15**
Unit 2	• History of plant nomenclature. • ICBN–Principles, Ranks, Typification, The principle of priority, Retention, Choice of rejection of names & epithet. • Classification and relative merits and demerits of major systems	**15**

	of classification Bentham & Hooker, Takhtajan and Bassey. • Advanced classification system: APG (IV).	
Unit 3	• The Taxonomic importance characters derived from the following disciplines: Morphology, Anatomy and Embryology. • Taxonomic tools: Flora and Monographs, Phytochemistry, and GIS. • Online Taxonomic Databases: International Plant Names Index (IPNI) and Plants of the World Online (POWO). • General account of Gujarat flora and Hot spots of India	**15**

Unit 4	• Taxonomical study of the following families with reference to their systematic position, morphology, floral variation and economic importance:
	• **Study of DICOTYLEDONS families:**
	  • Polypetalae: Menispermaceae, Capparaceae, Rutaceae, Meliaceae, and Apiaceae.
	  • Gamopetalae: Oleaceae, Salvadoraceae, Asclepiadaceae, Boraginaceae, Lamiaceae.
	  • Apetalae: Amaranthaceae, Euphorbiaceae, Casuarinaceae.
	• **Study of MONOCOTYLEDONS families:**
	  • Liliaceae, Poaceae.
		15

Suggested Readings:

1. Cole, A. J. (1969) Numerical Taxonomy,Academic Press, London.
2. Davis, P. H. and Heywood, V. H. (1973) Principles of Angiosperms Taxonomy. Robert Kreiger Pub. Co., New York.
3. Grant, V. 1971. Plant Speciation. Columbia University Press, New York.
4. Grant, W. F. (1984). Plant Biosystematics. Academic Press, London.
5. Harrison, H. J. (1971). New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd., UK.
7. Heywood, V. H. and Moore, D. M. (1984). Current Concepts in Plant Taxonomy. Academic Press, London.
8. Jones, A. D. and Wilbins, A. D. (1971). Variations and Adaptations in Plant Species. Hieman & Co. Educational Books Ltd., London.
9. Jones, S. B., Jr. and Luchsinger, A. E. (1986). Plant Systematics. McGraw-Hill Book Co., New York.
10. Nordenstam, B., El Gazaly, G. and Kassas, M. (2000). Plant Systematics for 2K Century. Portland Press Ltd., London.
11. Radford, A. E. (1986). Fundamentals of Plant Systematics. Harper & Row Publications,

USA.
12. Singh, H. (1978). Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger,Berlin.
13. Solbrig, O. T. (1970). Principles and Methods of Plant Biosystematics. The Mac Millan Co.- Collier-MacMillan Ltd., London.
14. Solbrig, O. T. and Solbrig, D. J. (1979). Population Biology and Evolution. Addison-Wesley Publication Co. Inc., USA.
15. Stebbins, G. L. (1974). Flowering Plant- Evolution Above Species Level. Edward Arnold Ltd., London
16. Stace, C. A. (1989). Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold Ltd., London.
17. Takhtajan, A. L. (1997). Diversity and Classification of Flowering Plants. ColumbiaUniversityPress, NewYork. Woodland, D. W. 1991. Contemporary Plant Systematics. Prentice Hall, NewJersey

DETAILED SYLLABUS OF TWO-YEAR PG ONLY COURSE WORK PROGRAM IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

DISCIPLINE SPECIFIC CORE COURSE-DSCC3							
COURSE	***SEMESTER***	***COURSE CODE***	***COURSE TITLE***	***CREDITS***	***LECTURES***	***THEORY***	
						CCE	***SEE***
Master Degree Course	***M.Sc. SEM-I***	***SC2M26 DSCC BOT103***	***CELL BIOLOGY***	**4**	**T=60hrs**	**50 MARKS**	**50 MARKS**

Course outcomes:	***Programme specific Learning and Course Outcomes:*** On completion of the course, the students will be able to: • Explain the structure and functions of cell wall, plasma membrane, and major cellular organelles. • Describe the ultrastructure and functions of chloroplasts, mitochondria, and other organelles. • Analyze the organization and role of cytoskeleton and mechanisms of cell cycle regulation. • Explain the processes of cell division including mitosis, meiosis, and programmed cell death. • Interpret the structure and organization of nucleus, chromatin, and specialized chromosomes. • Apply basic cell biology techniques including microscopy, staining, cell fractionation, and molecular cytological methods. **Pedagogy:** Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

THEORY UNIT	***TOPIC***	***NO. OF LECTURES (60hrs)***
Unit 1	• Plasmodesmata: Structure; role in movement of molecules and macromolecules. • Plasma membrane: Structure, models, and functions; sites for ATPases, ion carriers, channels and pumps; receptors. • Chloroplast and Mitochondria: Ultra Structure and Functions. • Other cellular organelles: Ultra-Structure and functions of Microbodies, Golgi apparatus, Lysosomes, endoplasmic reticulum, Ribosomes.	**15**
Unit 2	• Cytoskeleton; organization and role of microtubules and flagella. • Cell cycle: Control mechanisms; role of cyclins and cyclin-dependent kinases; cytokinesis and cell plate formation. • Cell Division: Amitosis, Mitosis and Meiosis. • Apoptosis/ Programmed Cell Death with reference to plant cells.	**15**
Unit 3	• Nucleus: Structure; nuclear pores; nucleosome organization, Nucleolus. • Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere. • Euchromatin and Hetero chromatin, Karyotype analysis. • Specialized type of chromosomes: Structure and functions of polytene, lamp brush and Sex chromosomes.	**15**

Unit 4	• Experimental approaches for studying Cells, Cell Fixation and Staining. • Microscopy: Various types of light Microscopy & Electron Microscopy, Phase-Contrast Microscopy and Fluorescent microscopy. • Cytochemical methods and cell fractionation (Flow Cytometry). • Techniques in cell biology: Immuno techniques; in situ hybridization to locate transcripts in cell types; FISH, GISH.	**15**

Suggested Readings:

1. Lewin, B. (2000). Genes VII. Oxford University Press, New York.
2. Rost, T. *et al*. (1998). Plant Biology. Wadsworth Publishing Co., California, USA.
3. Krishnamurthy, K. V. (2000). Methods in Cell Wall Cyto chemistry. CRC Press, Boca Raton, Florida.
4. De, D. N. (2000). Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
5. Fukui, K. and Nakayama, S. (1996). Plant Chromosomes: Laboratory Methods. CRC Press, BocaRaton, Florida.
6. Sharma, A. K. and Sharma, A. (1999). Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.
7. Buchanan B B, Gruisemm W, Jones R L (2015). Biochemistry and Molecular Biology of Plants, 2ndedition, Wiley Blackwell, New Jersey.
8. Hopkins W G, Huner NPA (2009) Introduction to Plant Physiology, 4th edition Wiley International edition, John Wiley & Sons, New York.
9. Taiz L, Zeiger E, Moller I M, Murph A (2015) Plant Physiology and Development, 6thedition, Sinurer Associates Inc Publishers, Sunderland, Massachusetts.
10. Frank B. Salisbury and Cleon W. Ross (1985). Plant Physiology Wadsworth Publishing Company, Belmont, California.
11. Robert M. Devlin (3rd edition) (1975) Plant Physiology Van Nostr and Reinhold Company, New York.
12. Walter Larcher (4thedition) (2003) Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups Springer Verlag, Berlin.
13. Hans Mohr and Peter Schopfer (2010) Plant Physiology Springer Verlag, Berlin. Edwin Oxlade (2007) Plant Physiology: The Structure of Plants Explained Glmp Ltd, Abergele, United Kingdom.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE-PDSCC4						
COURSE	***SEMESTER***	***COURSE CODE***	***COURSE TITLE***	***PRACTICAL***		
				Credits	***CCE***	***SEE***
Master Degree Course	***M.Sc. SEM-I***	**SC2M26 PDSCC BOT104**	**PLANT DIVERSITY –I, PLANT TAXONOMY & CELL BIOLOGY**	**4 (120 hrs)**	***50 MARKS***	***50 MARKS***

Course outcomes:

Programme specific Learning and Course Outcomes:

After the completion of the course the students will be able:

- Perform basic microbiological techniques including isolation of microbes, serial dilution, bacterial culture, and Gram staining.
- Identify and study the structure and reproduction of representative algae and fungi using laboratory specimens and slides.
- Recognize plant diseases based on symptoms and demonstrate understanding through specimen/chart-based identification.
- Apply herbarium techniques, prepare digital herbarium sheets, and use flora for plant identification and classification.
- Conduct field studies, document plant diversity, and prepare scientific reports with geo tagged evidence.
- Perform basic cytological techniques including preparation of mitotic and meiotic stages and isolation of cell organelles.
- Analyze cell structures and chromosomes using microscopic slides, charts, and imaging techniques (SEM/TEM).

Pedagogy: Lab. works/ Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

PRACTICALS	***NO. OF LECTURES* (120 hrs)**
GROUP - A	**40**

GROUP - A

1. Isolation of microbes from soil through serial dilution.
2. Demonstrate the culture of bacteria.
3. Conduct a field visit to any one of the ecosystems rich in algae to experience algal diversity. Submit a report with photographs.
4. Thallus structure and reproduction: Ulva, Diatoms, Dictyota and Polysiphonia.
5. Ultrastructure of Virions (through chart).
6. Gram staining - curd, root nodules.
7. Study of following Fungi:

•Zygomycotina (*Mucor*),

- •Ascomycotina (*Aspergillus*)
- •Basidiomycotina (*Polyporus*)
- •Deuteromycotina (*Colletotrichum*)

8. Study of following Plant diseases:
   - •Viral (Potato leaf roll-chart)
   - •Bacterial blight of Paddy
   - •Tikka disease in Groundnut

GROUP- B	**40**

1. Visit a recognized herbarium, practice herbarium technique
2. Methods of identification of plants and preparation of at least 15 Standard herbarium sheets.
3. Study of genera from Families as per Theory Syllabus.
4. Identify the genus and species of given plant specimens with the help of standard Flora.
5. To prepare Dichotomous key with the help of given specimens.
6. Conduct field work for a period of not less than 5 days to familiarize plants under the guidance of faculties and submit a field report with geotagged photos.

GROUP - C	**40**

1. Isolation of Chloroplast by centrifugation.
2. Isolation of mitochondria by ultracentrifugation.
3. Temporary stained preparation of Mitosis / Meiosis – Onion root tip, Ipomoea bud, Tradescantia bud, Aloe bud.
4. Study of Giant chromosomes from Salivary glands of Chyronomous larva (Polytene)/Chart.
5. Salivary glands of Drosophila (Lampbrush) - Chart.
6. Study of various cell organelles (as per syllabus) through permanent slide/charts/models.
7. Study of Karyotype in plant cells.
8. Demonstration of SEM and TEM - photograph.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
(Effective from June 2026-27 UNDER NEP-2020)
M. Sc.: BOTANY Practical: SEMESTER-I
PLANT DIVERSITY –I , PLANT TAXONOMY& CELL BIOLOGY
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE-DSCC4
SC2M26PDSCCBOT104

Date: **Time: 6 Hrs**
Place: **Total Marks: 50**

Instructions: Strictly follow the instructions given by examiner(s).

Q.1: Identify and Classify giving with suitable reasons of given Specimen "A" **05**

Q.2: Expose the reproductive organ from the given specimen "B". Prepare the Slide and draw neat and labeled diagram. Show your slide to the examiner. **05**

OR

Q.2: Expose and mount the given material "B" of plant pathogen. Prepare the slide and draw neat and labeled diagram. Show to the examiner. **05**

Q.3: Refer to the given specimens "C", and "D" to the respective families giving reasons including floral formula and floral diagram. **08**

Q.4: Identify the genus and species of given plant specimen "E" with the help of standard Flora. **05**

Q.5: Make a Temporary stained preparation of Mitosis / Meiosis from given material "F" and show your preparation to the examiner. **06**

Q.6: Spot – "G'. 'H' "I" and "J". **12**
Q.7: (A) Journal **03**
(B) Submission/Botanical Tour Report **03**
(C) Viva-voce **03**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><td colspan="9">MULTI DISCIPLINE COURSE-MDC1</td></tr>
<tr><td rowspan="2">COURSE</td><td rowspan="2">SEMES TER</td><td rowspan="2">COURSE CODE</td><td rowspan="2">COURSE TITLE</td><td rowspan="2">CREDITS</td><td rowspan="2">LECTURES</td><td colspan="2">THEORY</td></tr>
<tr><td>CCE</td><td>SEE</td></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 MDC BOT105</td><td>GENETICS</td><td>2</td><td>T=30hrs</td><td>25 Marks</td><td>25 Marks</td></tr>
<tr><td>Course outcomes:</td><td colspan="7">Programme specific Learning and Course Outcomes:
• Explain gene structure, genetic code, and mutations.
• Describe extra-chromosomal inheritance including chloroplast and mitochondrial genetics.
• Apply principles of Mendelian and non-Mendelian inheritance to solve genetic problems.
• Analyze chromosomal basis of inheritance including sex determination and chromosomal aberrations.
• Interpret linkage, crossing over, and construct basic genetic maps using test cross and chi-square analysis.
Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
<tr><td>THEORY UNIT</td><td colspan="6">TOPIC</td><td>NO. OF LECTURES (30hrs)</td></tr>
<tr><td>Unit 1</td><td colspan="6">Genetics – I
• Gene structure: Gene vs allele, fine structure of gene as cistron, recon and muton.
• Genetic code: Deciphering genetic code, properties of genetic code, initiation and termination codons, mutation and genetic code, wobble hypothesis, new genetic codes, overlapping and split genes.
• Extra chromosomal inheritance (maternal inheritance): Chloroplast genome (cp-DNA); Plastid inheritance in Mirabilis jalapa. Mitochondrial genome (mt-DNA); Mitochondrial inheritance in Zea mays (Male Sterility-Types, origin, induction and application).
• Petite in yeast and Porky in Neurospora. Comparison between Cp-DNA and Mt-DNA.</td><td>15</td></tr>
</table>

Unit 2	**Genetics - II** • Mendalian (mono & Di-hybridization) and Non-mendelian genetics (9:6:1), Epistasis (9:3:4 & 12:3:1), Polygenic inheritance (characteristics and Kernel colour in Wheat) and multiple alleles. • Chromosome theory and sex determination, chromosomal aberration. • Linkage and crossing over: Complete and incomplete linkage, Types of Crossing over, Three-point test cross and Chi square (X^2) test for segregation. • Linkage maps in Drosophila and chromosomal mapping.	**15**

Suggested Readings:

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
3. Busch, H. and Rothblum, L. (1982). Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. (1998). Genetics: Principles and Analysis (4h edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. (1999). Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
7. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. (1997). Human Genetics: Concepts and Applications edition). WCB McGraw Hill, USA.
9. Russel, P. J. (1998). Genetics (5th edition). The Benjamin/Cummings Publishing Company Inc., USA.
10. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><th colspan="7">MULTI DISCIPLINE COURSE-MDC2</th></tr>
<tr><th rowspan="2">COURSE</th><th rowspan="2">SEMESTER</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th colspan="3">PRACTICAL</th></tr>
<tr><th>Credits</th><th>CCE</th><th>SEE</th></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 PMDC BOT106</td><td>GENETICS</td><td>2 (60hrs)</td><td>25 Marks</td><td>25 Marks</td></tr>
<tr><td>Course outcomes:</td><td colspan="6">Programme specific Learning and Course Outcomes:
On completion of this course, the students will be able to:
• Explain gene structure, genetic code, and mutations.
• Describe extra-chromosomal inheritance including chloroplast and mitochondrial genetics.
• Apply principles of Mendelian and non-Mendelian inheritance to solve genetic problems.Analyze chromosomal basis of inheritance including sex determination and chromosomal aberrations.Interpret linkage, crossing over, and construct basic genetic maps using test cross and chi-square analysis.
Pedagogy: Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.</td></tr>
<tr><th colspan="6">PRACTICALS</th><th>NO. OF LECTURES (60 hrs)</th></tr>
<tr><td>Unit 1& 2</td><td colspan="5">1. Induction of polyploidy using Colchicine.
2. Study of permanent slides/ charts/ models/ photographs as per theory syllabus.
3. Solve the genetic problems based on topics covered in the theory syllabus.</td><td>60</td></tr>
</table>

Suggested Readings:

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
3. Busch, H. and Rothblum, L. (1982). Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. (1998). Genetics: Principles and Analysis (4h edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. (1999). Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
7. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. (1997). Human Genetics: Concepts and Applications edition). WCB McGraw Hill, USA.
9. Russel, P. J. (1998). Genetics (5th edition). The Benjamin/Cummings Publishing Company Inc., USA.
10. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
(Effective from June 2026-27 UNDER NEP-2020)
M. Sc.: BOTANY PRACTICAL: SEMESTER-I
(MULTI DISCIPLINE COURSES)
GENETICS
SC2M26PMDCBOT106

Date: **Time: 03:00Hrs**

Place: **Total Marks: 25**

Q.1: Make a temporary stained preparation of Giant chromosomes/Polyploidy from given material 'A' and show your preparation to the examiner. 04

Q.2: Solve and conclude the problems from genetics. 09
B. Polygenic inheritance
C. Three-point test cross
D. Chi square (X^2) test

Q.3: Comment upon the given spots/ Photographs/ Diagrams/ Models/ Charts. 06
E. Gene structure/Genetic code
F. Extra chromosomal inheritance/ Male Sterility in *Zea mays*

Q.4: (a) Journal 03
(b) Viva-voce 03

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><th colspan="8">VALUE ADDED COURSE-VAC</th></tr>
<tr><th rowspan="2">COURSE</th><th rowspan="2">SEMESTER</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th rowspan="2">Credits</th><th rowspan="2">Lectures</th><th colspan="2">THEORY</th></tr>
<tr><th>CCE</th><th>SEE</th></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 VAC BOT107</td><td>BIOFERTILIZER TECHNOLOGY</td><td>2</td><td>T=30hrs</td><td>25 Marks</td><td>25 Marks</td></tr>
<tr><td>Course outcomes</td><td colspan="7">Programme specific Learning and Course Outcomes:
1.This program will help students develop knowledge in bio fertilizer technology
2.This program will help students acquire laboratory, microscopy, and bio fertilizer skills. This program will help students build scientific, ethical, and professional competencies in Botany.
Pedagogy: Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.</td></tr>
<tr><th>THEORY UNIT</th><th colspan="6">TOPIC</th><th>NO. OF LECTURES (30hrs)</th></tr>
<tr><td>Unit 1</td><td colspan="6">• Biofertilizers: Definition, types and applications in agriculture.
• Characteristics of biofertilizers: Rhizobium, Azotobactor, phosphate-solubilizing microorganisms (PSMs), cyanobacteria, Azolla, mycorrhizae.
• Biological nitrogen fixation: Nitrogenase, substrates for nitrogenase, mechanism of action of nitrogenase, strategies to exclude oxygen and need to control hydrogen evolution, regulation of nitrogen fixation.</td><td>15</td></tr>
<tr><td>Unit 2</td><td colspan="6">• Rhizobium- legume symbiosis.
• Production technology: Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers.
• Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings, agronomical significance.</td><td>15</td></tr>
</table>

Suggested readings:

1. Gallon J R, Chaplin A E (1987) An Introduction to Nitrogen Fixation, Cassel Educational Limited, London.
2. Smith R J, Lea P J, Chaplin J R (1999) Nitrogen Fixation. In: Plant Biochemistry &Molecular Biology, 2ndedition, Lea P J, Lee good R C, John Wiley & Sons, New York, pp. 137-162.
3. Rai A N (1990) A Handbook of Symbiotic Cyanobacteria, CRC Press, BocaRaton, USA.
4. Postgate J R (1987) Nitrogen Fixation, 2 ndedition, Arnold, London.
5. Stacey G, Burris R H , Evans H J (1992) Biological Nitrogen Fixation, Chapman & Hall, NewYork.
6. Sprent J I, Sprent P (1990) Nitrogen Fixing Organisms: Pure and Applied Aspects. Chapman&Hall, London.
7. Kannaiyan S, Kumar K, Govindrajan K (2007) Biofertlizers Technology, Saujanya Books, NewDelhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
M.Sc. <u>COURSE WORK WITH RESEACH RPROGRAMME</u> 88 credits
***FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP*- 2020) *w.e.f.* June-2026**
General Pattern/Scheme of study components along with credits for Science faculty.
<u>Semester: I & II</u>

MASTER DEGREE COURSE (COURSE WORK WITH RESEACH) SCIPG103									
Part/Class	**Course Type**	**Subject code**	**Study Components**	**Hrs/ Week**	**Examination Marks**			**Credits**	**Exam Duration (Hours)**
					CCE	**SEE**	**Total**		
M.Sc. Semester -I		**SEMESTER-I**							
	DSCC1	SC2M26 DSCCBOT101	Plant Diversity-I	4	50	50	100	4	**02:30**
	DSCC2	SC2M26 DSCCBOT 102	Plant Taxonomy	4	50	50	100	4	
	DSCC3	SC2M26 DSCCBOT 103	Cell Biology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCCBOT 104	**PRACTICAL** Plant Diversity-I: Plant Taxonomy, Cell Biology	8	50	50	100	4	**06:00**
	MDC1	SC2M26 MDC BOT 105	Genetics	2	25	25	50	2	**02:00**
	MDC2	SC2M26 PMDCBOT106	**PRACTICAL** Genetics	4	25	25	50	2	**03:00**
	VAC	SC2M26 VACBOT107	Bio fertilizer Technology	2	25	25	50	2	**02:00**
		Total		**28**	**275**	**275**	**550**	**22**	
SEMESTER II									
M.Sc. Semester -II	**DSCC1**	SC2M26 DSCCBOT201	Plant Diversity-II	4	50	50	100	4	**02:30**
	DSCC2	SC2M26 DSCCBOT202	Plant Anatomy and Reproduction	4	50	50	100	4	
	DSCC3	SC2M26 DSCCBOT203	Plant Ecology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCC BOT204	**PRACTICAL** Plant Diversity-II: Plant Anatomy and Reproduction, Plant Ecology	8	50	50	100	4	**06:00**
	MDC	SC2M26MDC BOT205	Bio Chemistry	2	25	25	50	2	**02:00**
	SEC	SC2M26 PSECBOT206	**PRACTICAL** Bio Chemistry	4	25	25	50	2	**03:00**
	VOC	SC2M26 VOC BOT207	Air Pollution and Climate Change	2	25	25	50	2	**02:00**
	SWAYAM	**SWAYAM**	**SWAYAM- Select from Portal**						
		Total		**28**	**275**	**275**	**550**	**22**	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
M.Sc. <u>COURSE WORK WITH RESEACH RPROGRAMME</u> 88 credits
FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP- 2020) w.e.f. June-2026
General Pattern/Scheme of study components along with credits for Science faculty.
<u>Semester: III & IV</u>

MASTER DEGREE COURSE (ONLY COURSE WORK PROGRAMME) SCIPG103									
Part/Class	Course Type	Subject code	Study Components	Hrs/ Week	Examination Marks			Credits	Exam Duration (Hours)
					CCE	SEE	Total		
SEMESTER-III									
M.Sc. Semester -III	DSCC1	SC2M26DSCCBOT301	Plant Diversity-III	4	50	50	100	4	02:30
	DSCC2	SC2M26DSCCBOT302	Molecular Biology of Plants	4	50	50	100	4	
	DSCC3	SC2M26DSCCBOT303	Plant Physiology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCCBOT304	**PRACTICAL** Plant Diversity-III , Molecular Biology of Plants & Plant Physiology	8	50	50	100	4	06:00
	DSEC1	SC2M26DSECBOT305	Biodiversity conservation	2	25	25	50	2	02:00
	DSEC2	SC2M26 PDSECBOT306	**PRACTICAL** Biodiversity conservation	4	25	25	50	2	03:00
	DSEC3	SC2M26DSECBOT307	Herbal Medicine	2	25	25	50	2	02:00
		Total		**28**	**275**	**275**	**550**	**22**	
SEMESTER-IV									
M.Sc. Semester -IV	DSCC1	SC2MRPBOT401	Research Project	32	200	200	400	16	06:00
	DSCC2	SC2MSBOT401	Seminar	6	75	75	150	6	06:00
		Total		**38**	**275**	**275**	**550**	**22**	

DETAILED SYLLABUS OF TWO-YEAR PG COURSE WORK WITH RESEACH RPROGRAMME IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

DISCIPLINE SPECIFIC CORE COURSE –DSCC1							
COURSE	***SEMESTER***	***COURSE CODE***	***COURSE TITLE***	***Credits***	***Lectures***	***THEORY***	
						CCE	***SEE***
Master Degree Course	***M.Sc. I***	***SC2M26 DSCC BOT101***	***PLANT DIVERSITY - I***	***4***	**T=60hrs**	***50 MARKS***	***50 MARKS***

Course outcomes:	***Programme specific Learning and Course Outcomes:*** On completion of this course, the students will be able to: • Explain the structural and functional diversity of microorganisms including viruses, bacteria, and fungi, along with their modes of reproduction and genetic recombination. • Classify major groups of algae and fungi based on morphological, physiological, and reproductive characteristics. • Analyze microbial interactions and evaluate their applications in agriculture, medicine, food industry, and environmental management. • Describe the diversity, distribution, and ecological significance of algal groups with reference to their pigments, storage products, and thallus organization. • Interpret the life cycles and economic importance of fungi, including their roles in industry, medicine, and as biocontrol agents. • Identify plant diseases based on symptoms, causative agents, and modes of transmission. • Explain disease cycles, dissemination mechanisms, and plant defense strategies against pathogens. • Recommend appropriate control measures for major plant diseases caused by viral, bacterial, and fungal pathogens. **Pedagogy:** Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

THEORY UNIT	***TOPIC***	***NO. OF LECTURES* (60hrs)**
Unit 1	**Introduction and Application of Microbiology** • **Viruses:** Types of Viruses (on the basis of Genome), Viroid and Prions. Multiplication of λ phage lytic and lysogenic cycle. • **Bacteria:** Classification based on staining. Ultra structure of bacteria. • **Genetic recombination in bacteria** - conjugation, transformation and transduction.	**15**

	• **Microbial interactions in ecosystems**, Applications of microbes in agriculture, food and medicine. Microbes waste management and as biocontrol agents.	

Unit 2	**Introduction to Phycology**
	• Brief introduction to the modern classification by Lee (2016) [up to class].
	• Distribution, habitat diversity, range of thallus structure, pigment composition and photosynthetic end product in various groups of algae.
	• Salient features and thallus structure of algae in the following groups with special reference to the type(s) mentioned:
	    • Chlorophyta- Ulvophyceae – *Ulva*
	    • *Chrysophyta- Bacillariophyceae - Diatoms*
	    • Phaeophyta-Dictyotales- *Dictyota*
	    • Rhodophyceae - *Polysiphonia*
	• Application of algae in Environment and Industries..
		15

Unit 3	**MYCOLOGY**
	• Cellular Organization (Unicellular and Multicellular), Nutrition in fungi.
	• Reproduction in Fungi, Heterothallism.
	• General account of:
	    • Zygomycotina (*Mucor*)
	    • Ascomycotina (*Aspergillus*)
	    • Basidiomycotina (*Polyporus*)
	    • Deuteromycotina (*Colletotrichum*).
	• Economic Importance of Fungi: In Industry, Medicine and bio-control agent
		15

Unit 4	**PATHOLOGY** • **Plant Pathology:** Classification of plant diseases (on the basis of host and origin), General Symptoms of plant diseases. • **Dissemination of plant diseases** (Direct and Indirect). Defense mechanism (Morphological and Bio-Chemical). • **Plant pathogens:** Symptoms, Diseases cycle, Control measures: Viral (Potato leaf roll) and Bacterial (Bacterial blight of paddy)	**15**

	• **Plant pathogens:** Symptoms, Diseases cycle, Control measures: Fungal (Tikka disease in Groundnut and Powdery mildew of Cucurbits).	

Suggested Readings:

1. Adetunji, A. T., et al. (2023). *Next generation algae. Vol. I: Application in agriculture, food and environment*. John Wiley & Sons, Beverley, USA.
2. Campbell, R. (1987). *Plant microbiology*. ELBS Edward Arnold, London.
3. Dube, H. C. (2008). *Fungi, bacteria and viruses*. Agrobios, India.
4. Fritsch, F. E. (1955). *The structure and reproduction of algae* (Vols. I–II). Cambridge University Press, UK.
5. Bold, H. C., & Wynne M. J. (1978). *Introduction to algae: Structure and reproduction*. Prentice Hall, USA.
6. Kim, S. K. (2011). *Marine medicinal foods: Implications and applications of micro and macroalgae*. Academic Press, New York.
7. Moheimani,N.R.,McHenry,M.P.,deBoer,K.,&Bahri,P.A.(2015).*Biomassandbiofuels from microalgae*.SpringerInternationalPublishing,Switzerland.
8. Pelczar,M.J.,Chan,E.C.S.,&Krieg,N.R.(1993).*Microbiology*(Indianed.).TataMcGraw-Hill,New Delhi.
9. Sahoo,D.,&Seckbach,J.(2015).*Thealgaeworld*.Springer,Dordrecht,Heidelberg,NewYork.
10. Sharma, O. P. (2011).*Algae*. TataMcGraw-Hill,NewDelhi.
11. Smith,G.M.(1955).*Cryptogamicbotany:Vol.I–Algaeandfungi*.TataMcGraw-Hill, NewYork.
12. Sharma, P. D. (2011) Microbiology. Rastogi Publication. Meerut.
13. Pelczar M. J, Chan E. C. Sand Krieg N. R. (2004) Microbiology, Tata McGraw – Hall Publishing Company Ltd. NewDelhi.
14. Hait G; Bhattacharya K and Ghosh A. K. (2008) A Taxt Book of Botany,Vol-I, New Central Book Agency (P) Ltd. Kolkata.
15. SinghV; Pande P. Cand Jain D. K. (2008-09) A Taxt Book of Botany, rastogi Publication,Meerut.
16. Barsanti L, Gualtieri P (2006) Algae: Anatomy, Biochemistry and Biotechnology, CRC Press,Taylor and Francis, Boca Raton.
17. Bold H C, Wynne M J (1985) Introduction to the Algae, 2nd edition, Prentice-HallInc, NewJersey.
18. Kumar H D (1999) Introductory Phycology, 2nd edition, Affiliated East-West Press Pvt. Ltd.New Delhi
19. Fritsch F E (1935) The Structure and Reproduction of the Algae, Vol I, Cambridge University Press, Cambridge.
20. Fritsch F E (1945) The Structure and Reproduction of the Algae, Vol II, Cambridge University Press, Cambridge.
21. Lee R E (2008) Phycology, 4th edition, Cambridge University Press, Cambridge.
22. South G R, Whittick A (1998) Introduction to Phycology, Blackwell Scientific Publication, London.
23. Webster John (1980) Introduction to fungi, Cambridge University Press, Cambridge.
24. Alexopoulos C J, Mims C W, Blackwell M (1996) Introductory Mycology, John

Wiley and Sons, Inc, NewYork.
25. Carlile M J, Watkinson S C, Booday G W (2001) The Fungi, Academic Press, Cambidge.
26. Maheshwari R (2012) Fungi: Experimental Methods in Biology, CRC Press, Boca Raton, Florida.
27. Deacon J W, Blackwell M (1997) Introduction to Modern Mycology, Oxford.
28. Webster J, Roland W S (2007) Introduction to Fungi, Cambridge University Press, Cambridge
29. Rangaswamy, G and Mahadevan, A (1999) Diseases of crop plants in India (4th edn) Prentice Hall of Indian Pvt. New Delhi.
30. Pandey B. P. (2006) Plant Pathology-Pathogen and Plant Diseases. S. Chand & Co. Ltd. New Delhi.
31. Mehrotra R. S. (1991) Plant Pathology, Tata McGraw-Hill Publishing Co. Pvt. Ltd. New Delhi.
32. Agrios George N. (2004) Plant Pathology, Academic Press, Reed Elsevier India Pvt.
33. Ltd. New Delhi.
34. Sharma P. D. (2003) Microbiology and Plant Pathology, Rastogi Publications, Meerut.

DETAILED SYLLABUS OF TWO-YEAR PG COURSE WORK WITH RESEACH RPROGRAMME IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

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<table>
<tr><td colspan="8">DISCIPLINE SPECIFIC CORE COURSE-DSCC2
Programme Code: SCIPG103</td></tr>
<tr><td rowspan="2">COURSE</td><td rowspan="2">SEMESTER</td><td rowspan="2">COURSE CODE</td><td rowspan="2">COURSE TITLE</td><td rowspan="2">Credits</td><td rowspan="2">Lectures</td><td colspan="2">THEORY</td></tr>
<tr><td>CCE</td><td>SEE</td></tr>
<tr><td>Master Degree Course</td><td>M.Sc. I</td><td>SC2M26 DSCC BOT 102</td><td>PLANT TAXONOMY</td><td>4T</td><td>T=60hrs</td><td>50 MARKS</td><td>50 MARKS</td></tr>
<tr><td>Course outcomes:</td><td colspan="7">Programme specific Learning and Course Outcomes:

On completion of the course, the students will be able to:
• Explain the principles of taxonomy, taxonomic hierarchy, and categories used in plant classification.
• Describe the origin and evolution of angiosperms and understand herbarium techniques and botanical gardens.
• Apply rules of plant nomenclature (ICBN) and compare major classification systems.
• Analyze taxonomic characters derived from morphology, genetics, and cytology.
• Use taxonomic tools, databases, and regional flora for plant identification.
• Identify important plant families and explain their distribution, characteristics, and economic importance.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
<tr><td>THEORY UNIT</td><td colspan="6">TOPIC</td><td>NO. OF LECTURES
(60hrs)</td></tr>
<tr><td>Unit 1</td><td colspan="6">• Principles of taxonomy, Aims of taxonomy, Taxonomic hierarchy.
• Major categories: Families and other categories; Minor categories: Genus and Species.
• Origin of Angiosperms.
• Herbarium methodology, Important Herbaria and Botanical gardens (India and Global), Importance of Herbaria and Botanical gardens.</td><td>15</td></tr>
<tr><td>Unit 2</td><td colspan="6">• History of plant nomenclature.
• ICBN–Principles, Ranks, Typification, The principle of priority, Retention, Choice of rejection of names & epithet.</td><td>15</td></tr>
</table>

	• Classification and relative merits and demerits of major systems of classification Bentham & Hooker, Takhtajan and Bassey. • Advanced classification system: APG (IV).	
Unit 3	• The Taxonomic importance characters derived from the following disciplines: Morphology, Anatomy and Embryology. • Taxonomic tools: Flora and Monographs, Phytochemistry, and GIS. • Online Taxonomic Databases: International Plant Names Index (IPNI) and Plants of the World Online (POWO). • General account of Gujarat flora and Hot spots of India	**15**

Unit 4	• Taxonomical study of the following families with reference to their systematic position, morphology, floral variation and economic importance:
	• **Study of DICOTYLEDONS families:**
	  • Polypetalae: Menispermaceae, Capparaceae, Rutaceae, Meliaceae, and Apiaceae.
	  • Gamopetalae: Oleaceae, Salvadoraceae, Asclepiadaceae, Boraginaceae, Lamiaceae.
	  • Apetalae: Amaranthaceae, Euphorbiaceae, Casuarinaceae.
	• **Study of MONOCOTYLEDONS families:**
	  • Liliaceae, Poaceae.
		15

Suggested Readings:

1. Cole, A. J. (1969) Numerical Taxonomy,Academic Press, London.
2. Davis, P. H. and Heywood, V. H. (1973) Principles of Angiosperms Taxonomy. Robert Kreiger Pub. Co., New York.
3. Grant, V. 1971. Plant Speciation. Columbia University Press, New York.
4. Grant, W. F. (1984). Plant Biosystematics. Academic Press, London.
5. Harrison, H. J. (1971). New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd., UK.
7. Heywood, V. H. and Moore, D. M. (1984). Current Concepts in Plant Taxonomy. Academic Press, London.
8. Jones, A. D. and Wilbins, A. D. (1971). Variations and Adaptations in Plant Species. Hieman & Co. Educational Books Ltd., London.
9. Jones, S. B., Jr. and Luchsinger, A. E. (1986). Plant Systematics. McGraw-Hill Book Co., New York.
10. Nordenstam, B., El Gazaly, G. and Kassas, M. (2000). Plant Systematics for 2K Century. Portland Press Ltd., London.

11. Radford, A. E. (1986). Fundamentals of Plant Systematics. Harper & Row Publications, USA.
12. Singh, H. (1978). Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger,Berlin.
13. Solbrig, O. T. (1970). Principles and Methods of Plant Biosystematics. The Mac Millan Co.- Collier-MacMillan Ltd., London.
14. Solbrig, O. T. and Solbrig, D. J. (1979). Population Biology and Evolution. Addison-Wesley Publication Co. Inc., USA.
15. Stebbins, G. L. (1974). Flowering Plant- Evolution Above Species Level. Edward Arnold Ltd., London
16. Stace, C. A. (1989). Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold Ltd., London.
17. Takhtajan, A. L. (1997). Diversity and Classification of Flowering Plants. ColumbiaUniversityPress, NewYork. Woodland, D. W. 1991. Contemporary Plant Systematics. Prentice Hall, NewJersey

DETAILED SYLLABUS OF TWO-YEAR PG COURSE WORK WITH RESEACH RPROGRAMME IN BOTANY

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DISCIPLINE SPECIFIC CORE COURSE-DSCC3

COURSE	*SEMESTER*	*COURSE CODE*	*COURSE TITLE*	*CREDITS*	*LECTURES*	*THEORY*	
						CCE	*SEE*
Master Degree Course	*M.Sc. SEM-I*	*SC2M26 DSCC BOT103*	*CELL BIOLOGY*	**4**	**T=60hrs**	**50 MARKS**	**50 MARKS**

Course outcomes:

Programme specific Learning and Course Outcomes:

On completion of the course, the students will be able to:

- Explain the structure and functions of cell wall, plasma membrane, and major cellular organelles.
- Describe the ultrastructure and functions of chloroplasts, mitochondria, and other organelles.
- Analyze the organization and role of cytoskeleton and mechanisms of cell cycle regulation.
- Explain the processes of cell division including mitosis, meiosis, and programmed cell death.
- Interpret the structure and organization of nucleus, chromatin, and specialized chromosomes.
- Apply basic cell biology techniques including microscopy, staining, cell fractionation, and molecular cytological methods.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

THEORY UNIT	*TOPIC*	*NO. OF LECTURES* **(60hrs)**
Unit 1	• Plasmodesmata: Structure; role in movement of molecules and macromolecules. • Plasma membrane: Structure, models, and functions; sites for ATPases, ion carriers, channels and pumps; receptors. • Chloroplast and Mitochondria: Ultra Structure and Functions. • Other cellular organelles: Ultra-Structure and functions of Microbodies, Golgi apparatus, Lysosomes, endoplasmic reticulum, Ribosomes.	**15**
Unit 2	• Cytoskeleton; organization and role of microtubules and flagella. • Cell cycle: Control mechanisms; role of cyclins and cyclin-dependent kinases; cytokinesis and cell plate formation. • Cell Division: Amitosis, Mitosis and Meiosis. • Apoptosis/ Programmed Cell Death with reference to plant cells.	**15**
Unit 3	• Nucleus: Structure; nuclear pores; nucleosome organization, Nucleolus. • Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere. • Euchromatin and Hetero chromatin, Karyotype analysis. • Specialized type of chromosomes: Structure and functions of polytene, lamp	**15**

	brush and Sex chromosomes.	
Unit 4	• Experimental approaches for studying Cells, Cell Fixation and Staining. • Microscopy: Various types of light Microscopy & Electron Microscopy, Phase-Contrast Microscopy and Fluorescent microscopy. • Cytochemical methods and cell fractionation (Flow Cytometry). • Techniques in cell biology: Immuno techniques; in situ hybridization to locate transcripts in cell types; FISH, GISH.	**15**

Suggested Readings:

1. Lewin, B. (2000). Genes VII. Oxford University Press, New York.
2. Rost, T. *et al*. (1998). Plant Biology. Wadsworth Publishing Co., California, USA.
3. Krishnamurthy, K. V. (2000). Methods in Cell Wall Cyto chemistry. CRC Press, Boca Raton, Florida.
4. De, D. N. (2000). Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
5. Fukui, K. and Nakayama, S. (1996). Plant Chromosomes: Laboratory Methods. CRC Press, BocaRaton, Florida.
6. Sharma, A. K. and Sharma, A. (1999). Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.
7. Buchanan B B, Gruisemm W, Jones R L (2015). Biochemistry and Molecular Biology of Plants, 2ndedition, Wiley Blackwell, New Jersey.
8. Hopkins W G, Huner NPA (2009) Introduction to Plant Physiology, 4th edition Wiley International edition, John Wiley & Sons, New York.
9. Taiz L, Zeiger E, Moller I M, Murph A (2015) Plant Physiology and Development, 6thedition, Sinurer Associates Inc Publishers, Sunderland, Massachusetts.
10. Frank B. Salisbury and Cleon W. Ross (1985). Plant Physiology Wadsworth Publishing Company, Belmont, California.
11. Robert M. Devlin (3rd edition) (1975) Plant Physiology Van Nostr and Reinhold Company, New York.
12. Walter Larcher (4thedition) (2003) Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups Springer Verlag, Berlin.
13. Hans Mohr and Peter Schopfer (2010) Plant Physiology Springer Verlag, Berlin. Edwin Oxlade (2007) Plant Physiology: The Structure of Plants Explained Glmp Ltd, Abergele, United Kingdom.

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<table>
<tr><th colspan="7">PRACTICAL DISCIPLINE SPECIFIC CORE COURSE-DSCC4</th></tr>
<tr><th rowspan="2">COURSE</th><th rowspan="2">SEMESTER</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th colspan="3">PRACTICAL</th></tr>
<tr><th>Credits</th><th>CCE</th><th>SEE</th></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26
PDSCC
BOT104</td><td>PLANT DIVERSITY –I, PLANT TAXONOMY
&
CELL BIOLOGY</td><td>4
(120 hrs)</td><td>50 MARKS</td><td>50 MARKS</td></tr>
<tr><td>Course outcomes:</td><td colspan="6">Programme specific Learning and Course Outcomes:

After the completion of the course the students will be able:
• Perform basic microbiological techniques including isolation of microbes, serial dilution, bacterial culture, and Gram staining.
• Identify and study the structure and reproduction of representative algae and fungi using laboratory specimens and slides.
• Recognize plant diseases based on symptoms and demonstrate understanding through specimen/chart-based identification.
• Apply herbarium techniques, prepare digital herbarium sheets, and use flora for plant identification and classification.
• Conduct field studies, document plant diversity, and prepare scientific reports with geo tagged evidence.
• Perform basic cytological techniques including preparation of mitotic and meiotic stages and isolation of cell organelles.
• Analyze cell structures and chromosomes using microscopic slides, charts, and imaging techniques (SEM/TEM).
Pedagogy: Lab. works/ Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
</table>

<table>
<tr><th>PRACTICALS</th><th>NO. OF LECTURES
(120 hrs)</th></tr>
<tr><td><u>GROUP - A</u>
1. Isolation of microbes from soil through serial dilution.
2. Demonstrate the culture of bacteria.
3. Conduct a field visit to any one of the ecosystems rich in algae to experience algal diversity. Submit a report with photographs.
4. Thallus structure and reproduction: Ulva, Diatoms, Dictyota and Polysiphonia.
5. Ultrastructure of Virions (through chart).
6. Gram staining - curd, root nodules.
7. Study of following Fungi:</td><td>40</td></tr>
</table>

•Zygomycotina (*Mucor*), •Ascomycotina (*Aspergillus*) •Basidiomycotina (*Polyporus*) •Deuteromycotina (*Colletotrichum*) 8. Study of following Plant diseases: •Viral (Potato leaf roll-chart) •Bacterial blight of Paddy •Tikka disease in Groundnut	
GROUP- B 1. Visit a recognized herbarium, practice herbarium technique 2. Methods of identification of plants and preparation of at least 15 Standard herbarium sheets. 3. Study of genera from Families as per Theory Syllabus. 4. Identify the genus and species of given plant specimens with the help of standard Flora. 5. To prepare Dichotomous key with the help of given specimens. 6. Conduct field work for a period of not less than 5 days to familiarize plants under the guidance of faculties and submit a field report with geotagged photos.	**40**
GROUP - C 1. Isolation of Chloroplast by centrifugation. 2. Isolation of mitochondria by ultracentrifugation. 3. Temporary stained preparation of Mitosis / Meiosis – Onion root tip, Ipomoea bud, Tradescantia bud, Aloe bud. 4. Study of Giant chromosomes from Salivary glands of Chyronomous larva (Polytene)/Chart. 5. Salivary glands of Drosophila (Lampbrush) - Chart. 6. Study of various cell organelles (as per syllabus) through permanent slide/charts/models. 7. Study of Karyotype in plant cells. 8. Demonstration of SEM and TEM - photograph.	**40**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
(Effective from June 2026-27 UNDER NEP-2020)
M. Sc.: BOTANY Practical: SEMESTER-I
PLANT DIVERSITY –I , PLANT TAXONOMY& CELL BIOLOGY
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE-DSCC4
SC2M26PDSCCBOT104

Date: **Time: 6 Hrs**
Place: **Total Marks: 50**

Instructions: Strictly follow the instructions given by examiner(s).

Q.1: Identify and Classify giving with suitable reasons of given Specimen "A" **05**

Q.2: Expose the reproductive organ from the given specimen "B". Prepare the Slide and draw neat and labeled diagram. Show your slide to the examiner. **05**

OR

Q.2: Expose and mount the given material "B" of plant pathogen. Prepare the slide and draw neat and labeled diagram. Show to the examiner. **05**

Q.3: Refer to the given specimens "C", and "D" to the respective families giving reasons including floral formula and floral diagram. **08**

Q.4: Identify the genus and species of given plant specimen "E" with the help of standard Flora. **05**

Q.5: Make a Temporary stained preparation of Mitosis / Meiosis from given material "F" and show your preparation to the examiner. **06**

Q.6: Spot – "G'. 'H' "I" and "J". **12**
Q.7: (A) Journal **03**
(B) Submission/Botanical Tour Report **03**
(C) Viva-voce **03**

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<table>
<tr><td colspan="8">MULTI DISCIPLINE COURSE-MDC1</td></tr>
<tr><td rowspan="2">COURSE</td><td rowspan="2">SEMES TER</td><td rowspan="2">COURSE CODE</td><td rowspan="2">COURSE TITLE</td><td rowspan="2">CREDITS</td><td rowspan="2">LECTURES</td><td colspan="2">THEORY</td></tr>
<tr><td>CCE</td><td>SEE</td></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 MDC BOT105</td><td>GENETICS</td><td>2</td><td>T=30hrs</td><td>25 Marks</td><td>25 Marks</td></tr>
<tr><td>Course outcomes:</td><td colspan="7">Programme specific Learning and Course Outcomes:
• Explain gene structure, genetic code, and mutations.
• Describe extra-chromosomal inheritance including chloroplast and mitochondrial genetics.
• Apply principles of Mendelian and non-Mendelian inheritance to solve genetic problems.
• Analyze chromosomal basis of inheritance including sex determination and chromosomal aberrations.
• Interpret linkage, crossing over, and construct basic genetic maps using test cross and chi-square analysis.
Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
<tr><td>THEORY UNIT</td><td colspan="6">TOPIC</td><td>NO. OF LECTURES (30hrs)</td></tr>
<tr><td>Unit 1</td><td colspan="6">Genetics – I
• Gene structure: Gene vs allele, fine structure of gene as cistron, recon and muton.
• Genetic code: Deciphering genetic code, properties of genetic code, initiation and termination codons, mutation and genetic code, wobble hypothesis, new genetic codes, overlapping and split genes.
• Extra chromosomal inheritance (maternal inheritance): Chloroplast genome (cp-DNA); Plastid inheritance in Mirabilis jalapa. Mitochondrial genome (mt-DNA); Mitochondrial inheritance in Zea mays (Male Sterility-Types, origin, induction and application).
• Petite in yeast and Porky in Neurospora. Comparison between Cp-DNA and Mt-DNA.</td><td>15</td></tr>
</table>

Unit 2	**Genetics - II** • Mendalian (mono & Di-hybridization) and Non-mendelian genetics (9:6:1), Epistasis (9:3:4 & 12:3:1), Polygenic inheritance (characteristics and Kernel colour in Wheat) and multiple alleles. • Chromosome theory and sex determination, chromosomal aberration. • Linkage and crossing over: Complete and incomplete linkage, Types of Crossing over, Three-point test cross and Chi square (X^2) test for segregation. • Linkage maps in Drosophila and chromosomal mapping.	**15**

Suggested Readings:

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
3. Busch, H. and Rothblum, L. (1982). Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. (1998). Genetics: Principles and Analysis (4h edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. (1999). Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
7. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. (1997). Human Genetics: Concepts and Applications edition). WCB McGraw Hill, USA.
9. Russel, P. J. (1998). Genetics (5th edition). The Benjamin/Cummings Publishing Company Inc., USA.
10. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.

DETAILED SYLLABUS OF TWO-YEAR PG COURSE WORK WITH RESEACH RPROGRAMME IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

MULTI DISCIPLINE COURSE-MDC2						
COURSE	***SEMESTER***	***COURSE CODE***	***COURSE TITLE***	***PRACTICAL***		
				Credits	***CCE***	***SEE***
Master Degree Course	***M.Sc. SEM-I***	**SC2M26 PMDCBOT106**	**GENETICS**	**2 (60hrs)**	**25 Marks**	**25 Marks**

Course outcomes:	***Programme specific Learning and Course Outcomes:*** On completion of this course, the students will be able to: • Explain gene structure, genetic code, and mutations. Describe extra-chromosomal inheritance including chloroplast and mitochondrial genetics. Apply principles of Mendelian and non-Mendelian inheritance to solve genetic problems. Analyze chromosomal basis of inheritance including sex determination and chromosomal aberrations. Interpret linkage, crossing over, and construct basic genetic maps using test cross and chi-square analysis. **Pedagogy:** Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.

PRACTICALS		***NO. OF LECTURES***
Unit 1& 2	1. Induction of polyploidy using Colchicine. 2. Study of permanent slides/ charts/ models/ photographs as per theory syllabus. 3. Solve the genetic problems based on topics covered in the theory syllabus.	**60**

Suggested Readings:

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
3. Busch, H. and Rothblum, L. (1982). Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. (1998). Genetics: Principles and Analysis (4h edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. (1999). Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
7. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. (1997). Human Genetics: Concepts and Applications edition). WCB McGraw Hill, USA.
9. Russel, P. J. (1998). Genetics (5th edition). The Benjamin/Cummings Publishing Company Inc., USA.
10. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
(Effective from June 2026-27 UNDER NEP-2020)
M. Sc.: BOTANY PRACTICAL: SEMESTER-I
(MULTI DISCIPLINE COURSES)
GENETICS
SC2M26PMDCBOT106

Date: **Time: 03:00Hrs**

Place: **Total Marks: 25**

Q.1: Make a temporary stained preparation of Giant chromosomes/Polyploidy from given material 'A' and show your preparation to the examiner. **04**

Q.2: Solve and conclude the problems from genetics. **09**
B. Polygenic inheritance
C. Three-point test cross
D. Chi square (X^2) test

Q.3: Comment upon the given spots/ Photographs/ Diagrams/ Models/ Charts. **06**
E. Gene structure/Genetic code
F. Extra chromosomal inheritance/ Male Sterility in *Zea mays*

Q.4: (a) Journal **03**
(b) Viva-voce **03**

VALUE ADDED COURSE-VAC

COURSE	*SEMESTER*	*COURSE CODE*	*COURSE TITLE*	*Credits*	*Lectures*	*THEORY*	
						CCE	*SEE*
Master Degree Course	*M.Sc. SEM-I*	**SC2M26 VAC BOT107**	**BIOFERTILIZER TECHNOLOGY**	**2**	**T=30hrs**	**25 Marks**	**25 Marks**

Course outcomes	***Programme specific Learning and Course Outcomes:*** 1.This program will help students develop knowledge in bio fertilizer technology 2.This program will help students acquire laboratory, microscopy, and bio fertilizer skills. This program will help students build scientific, ethical, and professional competencies in Botany. **Pedagogy:** Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.

THEORY UNIT	*TOPIC*	*NO. OF LECTURES*
Unit 1	• Biofertilizers: Definition, types and applications in agriculture. • Characteristics of biofertilizers: Rhizobium, Azotobacter, phosphate-solubilizing microorganisms (PSMs), cyanobacteria, Azolla, mycorrhizae. • Biological nitrogen fixation: Nitrogenase, substrates for nitrogenase, mechanism of action of nitrogenase, strategies to exclude oxygen and need to control hydrogen evolution, regulation of nitrogen fixation.	**15**
Unit 2	• Rhizobium- legume symbiosis. • Production technology: Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers. • Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings, agronomical significance.	**15**

Suggested readings:

1. Gallon J R, Chaplin A E (1987) An Introduction to Nitrogen Fixation, Cassel Educational Limited, London.
2. Smith R J, Lea P J, Chaplin J R (1999) Nitrogen Fixation. In: Plant Biochemistry &Molecular Biology, 2ndedition, Lea P J, Lee good R C, John Wiley & Sons, New York, pp. 137-162.
3. Rai A N (1990) A Handbook of Symbiotic Cyanobacteria, CRC Press, BocaRaton, USA.
4. Postgate J R (1987) Nitrogen Fixation, 2 ndedition, Arnold, London.
5. Stacey G, Burris R H , Evans H J (1992) Biological Nitrogen Fixation, Chapman & Hall, NewYork.
6. Sprent J I, Sprent P (1990) Nitrogen Fixing Organisms: Pure and Applied Aspects. Chapman&Hall, London.
7. Kannaiyan S, Kumar K, Govindrajan K (2007) Biofertlizers Technology, Saujanya Books, NewDelhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
M.Sc. ONLY RESEACH RPROGRAMME 88 credits
***FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP-* 2020) *w.e.f.* June-2026**
General Pattern/Scheme of study components along with credits for Science faculty.
Semester: I & II

MASTER DEGREE COURSE (ONLY RESEACH RPROGRAMME) SCIPG103									
Part/Class	**Course Type**	**Subject code**	**Study Components**	**Hrs/ Week**	**Examination Marks**			**Credits**	**Exam Duration (Hours)**
					CCE	**SEE**	**Total**		
M.Sc. Semester -I		**SEMESTER-I**							
	DSCC1	SC2M26 DSCCBOT101	Plant Diversity-I	4	50	50	100	4	**02:30**
	DSCC2	SC2M26 DSCCBOT 102	Plant Taxonomy	4	50	50	100	4	
	DSCC3	SC2M26 DSCCBOT 103	Cell Biology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCC BOT 104	**PRACTICAL** Plant Diversity-I: Plant Taxonomy, Cell Biology	8	50	50	100	4	**06:00**
	MDC1	SC2M26 MDC BOT 105	Genetics	2	25	25	50	2	**02:00**
	MDC2	SC2M26 PMDCBOT106	**PRACTICAL** Genetics	4	25	25	50	2	**03:00**
	VAC	SC2M26 VACBOT107	Bio fertilizer Technology	2	25	25	50	2	**02:00**
		Total		**28**	**275**	**275**	**550**	**22**	
SEMESTER II									
M.Sc. Semester -II	**DSCC1**	SC2M26 DSCCBOT201	Plant Diversity-II	4	50	50	100	4	**02:30**
	DSCC2	SC2M26 DSCCBOT202	Plant Anatomy and Reproduction	4	50	50	100	4	
	DSCC3	SC2M26 DSCCBOT203	Plant Ecology	4	50	50	100	4	
	DSCC4	SC2M26 PDSCCBOT204	**PRACTICAL** Plant Diversity-II: Plant Anatomy and Reproduction, Plant Ecology	8	50	50	100	4	**06:00**
	MDC	SC2M26MDC BOT205	Bio Chemistry	2	25	25	50	2	**02:00**
	SEC	SC2M26 PSECBOT206	**PRACTICAL** Bio Chemistry	4	25	25	50	2	**03:00**
	VOC	SC2M26 VOC BOT207	Air Pollution and Climate Change	2	25	25	50	2	**02:00**
	SWAYAM	**SWAYAM**	**SWAYAM- Select from Portal**						
		Total		**28**	**275**	**275**	**550**	**22**	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
M.Sc. ONLY ONLY RESEARCH PROGRAMME 88 credits
FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP- 2020) w.e.f. June-2026
General Pattern/Scheme of study components along with credits for Science faculty.
Semester: III & IV

MASTER DEGREE COURSE (ONLY RESEARCH PROGRAMME) SCIPG103									
Part/Class	Course Type	Subject code	Study Components	Hrs/ Week	Examination Marks			Credits	Exam Duration (Hours)
					CCE	SEE	Total		
M.Sc. Semester -III	SEMESTER-III								
	DSCC1	SC2MRPBOT301	Research Project	44	275	275	550	22	06:00
		Total		**44**	**275**	**275**	**550**	**22**	
M.Sc. Semester -IV	SEMESTER-IV								
	DSCC1	SC2MRPBOT401	Research Project	44	275	275	550	22	06:00
		Total		**44**	**275**	**275**	**550**	**22**	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><td colspan="8">DISCIPLINE SPECIFIC CORE COURSE: DSCC-1
Programme Code: SCIPG103</td></tr>
<tr><td rowspan="2">COURSE</td><td rowspan="2">SEMESTER</td><td rowspan="2">COURSE CODE</td><td rowspan="2">COURSE TITLE</td><td rowspan="2">Credits</td><td rowspan="2">Lectures</td><td colspan="2">THEORY</td></tr>
<tr><td>CCE</td><td>SEE</td></tr>
<tr><td>Master Degree Course</td><td>M.Sc. I</td><td>SC2M26 DSCC BOT101</td><td>PLANT DIVERSITY - I</td><td>4</td><td>T=60hrs</td><td>50 MARKS</td><td>50 MARKS</td></tr>
<tr><td>Course outcomes:</td><td colspan="7">Programme specific Learning and Course Outcomes:
On completion of this course, the students will be able to:
Explain the structural and functional diversity of microorganisms including viruses, bacteria, and fungi, along with their modes of reproduction and genetic recombination.
Classify major groups of algae and fungi based on morphological, physiological, and reproductive characteristics.
Analyze microbial interactions and evaluate their applications in agriculture, medicine, food industry, and environmental management.
Describe the diversity, distribution, and ecological significance of algal groups with reference to their pigments, storage products, and thallus organization.
Interpret the life cycles and economic importance of fungi, including their roles in industry, medicine, and as biocontrol agents.
Identify plant diseases based on symptoms, causative agents, and modes of transmission.
Explain disease cycles, dissemination mechanisms, and plant defense strategies against pathogens.
Recommend appropriate control measures for major plant diseases caused by viral, bacterial, and fungal pathogens.
Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
<tr><td>THEORY UNIT</td><td colspan="6">TOPIC</td><td>NO. OF LECTURES
(60hrs)</td></tr>
<tr><td>Unit 1</td><td colspan="6">Introduction and Application of Microbiology
Viruses: Types of Viruses (on the basis of Genome), Viroid and Prions. Multiplication of λ phage lytic and lysogenic cycle.
Bacteria: Classification based on staining. Ultra structure of bacteria.
Genetic recombination in bacteria - conjugation, transformation and transduction.</td><td>15</td></tr>
</table>

	• **Microbial interactions in ecosystems**, Applications of microbes in agriculture, food and medicine. Microbes waste management and as biocontrol agents.	

Unit 2	**Introduction to Phycology**
	• Brief introduction to the modern classification by Lee (2016) [up to class].
	• Distribution, habitat diversity, range of thallus structure, pigment composition and photosynthetic end product in various groups of algae.
	• Salient features and thallus structure of algae in the following groups with special reference to the type(s) mentioned:
	    • Chlorophyta- Ulvophyceae – *Ulva*
	    • *Chrysophyta- Bacillariophyceae - Diatoms*
	    • Phaeophyta-Dictyotales- *Dictyota*
	    • Rhodophyceae - *Polysiphonia*
	• Application of algae in Environment and Industries..
		15

Unit 3	**MYCOLOGY**
	• Cellular Organization (Unicellular and Multicellular), Nutrition in fungi.
	• Reproduction in Fungi, Heterothallism.
	• General account of:
	    • Zygomycotina (*Mucor*)
	    • Ascomycotina (*Aspergillus*)
	    • Basidiomycotina (*Polyporus*)
	    • Deuteromycotina (*Colletotrichum*).
	• Economic Importance of Fungi: In Industry, Medicine and bio-control agent
		15

Unit 4	**PATHOLOGY** • **Plant Pathology:** Classification of plant diseases (on the basis of host and origin), General Symptoms of plant diseases. • **Dissemination of plant diseases** (Direct and Indirect). Defense mechanism (Morphological and Bio-Chemical). • **Plant pathogens:** Symptoms, Diseases cycle, Control measures: Viral (Potato leaf roll) and Bacterial (Bacterial blight of paddy)	**15**

	• **Plant pathogens:** Symptoms, Diseases cycle, Control measures: Fungal (Tikka disease in Groundnut and Powdery mildew of Cucurbits).	

Suggested Readings:

1. Adetunji, A. T., et al. (2023). *Next generation algae. Vol. I: Application in agriculture, food and environment*. John Wiley & Sons, Beverley, USA.
2. Campbell, R. (1987). *Plant microbiology*. ELBS Edward Arnold, London.
3. Dube, H. C. (2008). *Fungi, bacteria and viruses*. Agrobios, India.
4. Fritsch, F. E. (1955). *The structure and reproduction of algae* (Vols. I–II). Cambridge University Press, UK.
5. Bold, H. C., & Wynne M. J. (1978). *Introduction to algae: Structure and reproduction*. Prentice Hall, USA.
6. Kim, S. K. (2011). *Marine medicinal foods: Implications and applications of micro and macroalgae*. Academic Press, New York.
7. Moheimani,N.R.,McHenry,M.P.,deBoer,K.,&Bahri,P.A.(2015).*Biomassandbiofuels from microalgae*.SpringerInternationalPublishing,Switzerland.
8. Pelczar,M.J.,Chan,E.C.S.,&Krieg,N.R.(1993).*Microbiology*(Indianed.).TataMcGraw-Hill,New Delhi.
9. Sahoo,D.,&Seckbach,J.(2015).*Thealgaeworld*.Springer,Dordrecht,Heidelberg,NewYork.
10. Sharma, O. P. (2011).*Algae*. TataMcGraw-Hill,NewDelhi.
11. Smith,G.M.(1955).*Cryptogamicbotany:Vol.I–Algaeandfungi*.TataMcGraw-Hill, NewYork.
12. Sharma, P. D. (2011) Microbiology. Rastogi Publication. Meerut.
13. Pelczar M. J, Chan E. C. Sand Krieg N. R. (2004) Microbiology, Tata McGraw – Hall Publishing Company Ltd. NewDelhi.
14. Hait G; Bhattacharya K and Ghosh A. K. (2008) A Taxt Book of Botany,Vol-I, New Central Book Agency (P) Ltd. Kolkata.
15. SinghV; Pande P. Cand Jain D. K. (2008-09) A Taxt Book of Botany, rastogi Publication,Meerut.
16. Barsanti L, Gualtieri P (2006) Algae: Anatomy, Biochemistry and Biotechnology, CRC Press,Taylor and Francis, Boca Raton.
17. Bold H C, Wynne M J (1985) Introduction to the Algae, 2nd edition, Prentice-HallInc, NewJersey.
18. Kumar H D (1999) Introductory Phycology, 2nd edition, Affiliated East-West Press Pvt. Ltd.New Delhi
19. Fritsch F E (1935) The Structure and Reproduction of the Algae, Vol I, Cambridge University Press, Cambridge.
20. Fritsch F E (1945) The Structure and Reproduction of the Algae, Vol II, Cambridge University Press, Cambridge.
21. Lee R E (2008) Phycology, 4th edition, Cambridge University Press, Cambridge.
22. South G R, Whittick A (1998) Introduction to Phycology, Blackwell Scientific Publication, London.
23. Webster John (1980) Introduction to fungi, Cambridge University Press, Cambridge.
24. Alexopoulos C J, Mims C W, Blackwell M (1996) Introductory Mycology, John

Wiley and Sons, Inc, NewYork.
25. Carlile M J, Watkinson S C, Booday G W (2001) The Fungi, Academic Press, Cambidge.
26. Maheshwari R (2012) Fungi: Experimental Methods in Biology, CRC Press, Boca Raton, Florida.
27. Deacon J W, Blackwell M (1997) Introduction to Modern Mycology, Oxford.
28. Webster J, Roland W S (2007) Introduction to Fungi, Cambridge University Press, Cambridge
29. Rangaswamy, G and Mahadevan, A (1999) Diseases of crop plants in India (4th edn) Prentice Hall of Indian Pvt. New Delhi.
30. Pandey B. P. (2006) Plant Pathology-Pathogen and Plant Diseases. S. Chand & Co. Ltd. New Delhi.
31. Mehrotra R. S. (1991) Plant Pathology, Tata McGraw-Hill Publishing Co. Pvt. Ltd. New Delhi.
32. Agrios George N. (2004) Plant Pathology, Academic Press, Reed Elsevier India Pvt.
33. Ltd. New Delhi.
34. Sharma P. D. (2003) Microbiology and Plant Pathology, Rastogi Publications, Meerut.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

DISCIPLINE SPECIFIC CORE COURSE: DSCC-2

Programme Code: SCIPG103

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	Credits	Lectures	THEORY	
						CCE	SEE
Master Degree Course	M.Sc. I	SC2M26 DSCC BOT 102	PLANT TAXONOMY	4T	T=60hrs	50 MARKS	50 MARKS

Course outcomes:

Programme specific Learning and Course Outcomes:

On completion of the course, the students will be able to:

- Explain the principles of taxonomy, taxonomic hierarchy, and categories used in plant classification.
- Describe the origin and evolution of angiosperms and understand herbarium techniques and botanical gardens.
- Apply rules of plant nomenclature (ICBN) and compare major classification systems.
- Analyze taxonomic characters derived from morphology, genetics, and cytology.
- Use taxonomic tools, databases, and regional flora for plant identification.
- Identify important plant families and explain their distribution, characteristics, and economic importance.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

THEORY UNIT	TOPIC	NO. OF LECTURES (60hrs)
Unit 1	• Principles of taxonomy, Aims of taxonomy, Taxonomic hierarchy. • Major categories: Families and other categories; Minor categories: Genus and Species. • Origin of Angiosperms. • Herbarium methodology, Important Herbaria and Botanical gardens (India and Global), Importance of Herbaria and Botanical gardens.	**15**
Unit 2	• History of plant nomenclature. • ICBN–Principles, Ranks, Typification, The principle of priority, Retention, Choice of rejection of names & epithet.	**15**

	• Classification and relative merits and demerits of major systems of classification Bentham & Hooker, Takhtajan and Bassey. • Advanced classification system: APG (IV).	
Unit 3	• The Taxonomic importance characters derived from the following disciplines: Morphology, Anatomy and Embryology. • Taxonomic tools: Flora and Monographs, Phytochemistry, and GIS. • Online Taxonomic Databases: International Plant Names Index (IPNI) and Plants of the World Online (POWO). • General account of Gujarat flora and Hot spots of India	**15**

Unit 4	• Taxonomical study of the following families with reference to their systematic position, morphology, floral variation and economic importance:
	• **Study of DICOTYLEDONS families:**
	  • Polypetalae: Menispermaceae, Capparaceae, Rutaceae, Meliaceae, and Apiaceae.
	  • Gamopetalae: Oleaceae, Salvadoraceae, Asclepiadaceae, Boraginaceae, Lamiaceae.
	  • Apetalae: Amaranthaceae, Euphorbiaceae, Casuarinaceae.
	• **Study of MONOCOTYLEDONS families:**
	  • Liliaceae, Poaceae.
		15

Suggested Readings:

1. Cole, A. J. (1969) Numerical Taxonomy,Academic Press, London.
2. Davis, P. H. and Heywood, V. H. (1973) Principles of Angiosperms Taxonomy. Robert Kreiger Pub. Co., New York.
3. Grant, V. 1971. Plant Speciation. Columbia University Press, New York.
4. Grant, W. F. (1984). Plant Biosystematics. Academic Press, London.
5. Harrison, H. J. (1971). New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd., UK.
7. Heywood, V. H. and Moore, D. M. (1984). Current Concepts in Plant Taxonomy. Academic Press, London.
8. Jones, A. D. and Wilbins, A. D. (1971). Variations and Adaptations in Plant Species. Hieman & Co. Educational Books Ltd., London.
9. Jones, S. B., Jr. and Luchsinger, A. E. (1986). Plant Systematics. McGraw-Hill Book Co., New York.
10. Nordenstam, B., El Gazaly, G. and Kassas, M. (2000). Plant Systematics for 2K Century. Portland Press Ltd., London.

11. Radford, A. E. (1986). Fundamentals of Plant Systematics. Harper & Row Publications, USA.
12. Singh, H. (1978). Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger,Berlin.
13. Solbrig, O. T. (1970). Principles and Methods of Plant Biosystematics. The Mac Millan Co.- Collier-MacMillan Ltd., London.
14. Solbrig, O. T. and Solbrig, D. J. (1979). Population Biology and Evolution. Addison-Wesley Publication Co. Inc., USA.
15. Stebbins, G. L. (1974). Flowering Plant- Evolution Above Species Level. Edward Arnold Ltd., London
16. Stace, C. A. (1989). Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold Ltd., London.
17. Takhtajan, A. L. (1997). Diversity and Classification of Flowering Plants. ColumbiaUniversityPress, NewYork. Woodland, D. W. 1991. Contemporary Plant Systematics. Prentice Hall, NewJersey

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

DISCIPLINE SPECIFIC CORE COURSE-DSCC3

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS	LECTURES	THEORY	
						CCE	SEE
Master Degree Course	M.Sc. SEM-I	SC2M26D SCC BOT103	CELL BIOLOGY	4	T=60hrs	50 MARKS	50 MARKS

Course outcomes:

Programme specific Learning and Course Outcomes:

On completion of the course, the students will be able to:

- Explain the structure and functions of cell wall, plasma membrane, and major cellular organelles.
- Describe the ultrastructure and functions of chloroplasts, mitochondria, and other organelles.
- Analyze the organization and role of cytoskeleton and mechanisms of cell cycle regulation.
- Explain the processes of cell division including mitosis, meiosis, and programmed cell death.
- Interpret the structure and organization of nucleus, chromatin, and specialized chromosomes.
- Apply basic cell biology techniques including microscopy, staining, cell fractionation, and molecular cytological methods.

Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.

THEORY UNIT	TOPIC	NO. OF LECTURES (60hrs)
Unit 1	• Plasmodesmata: Structure; role in movement of molecules and macromolecules. • Plasma membrane: Structure, models, and functions; sites for ATPases, ion carriers, channels and pumps; receptors. • Chloroplast and Mitochondria: Ultra Structure and Functions. • Other cellular organelles: Ultra-Structure and functions of Microbodies, Golgi apparatus, Lysosomes, endoplasmic reticulum, Ribosomes.	**15**
Unit 2	• Cytoskeleton; organization and role of microtubules and flagella. • Cell cycle: Control mechanisms; role of cyclins and cyclin-dependent kinases; cytokinesis and cell plate formation. • Cell Division: Amitosis, Mitosis and Meiosis. • Apoptosis/ Programmed Cell Death with reference to plant cells.	**15**
Unit 3	• Nucleus: Structure; nuclear pores; nucleosome organization, Nucleolus. • Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere. • Euchromatin and Hetero chromatin, Karyotype analysis. • Specialized type of chromosomes: Structure and functions of polytene, lamp brush and Sex chromosomes.	**15**

Unit 4	• Experimental approaches for studying Cells, Cell Fixation and Staining. • Microscopy: Various types of light Microscopy & Electron Microscopy, Phase-Contrast Microscopy and Fluorescent microscopy. • Cytochemical methods and cell fractionation (Flow Cytometry). • Techniques in cell biology: Immuno techniques; in situ hybridization to locate transcripts in cell types; FISH, GISH.	**15**

Suggested Readings:

1. Lewin, B. (2000). Genes VII. Oxford University Press, New York.
2. Rost, T. *et al*. (1998). Plant Biology. Wadsworth Publishing Co., California, USA.
3. Krishnamurthy, K. V. (2000). Methods in Cell Wall Cyto chemistry. CRC Press, Boca Raton, Florida.
4. De, D. N. (2000). Plant Cell Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
5. Fukui, K. and Nakayama, S. (1996). Plant Chromosomes: Laboratory Methods. CRC Press, BocaRaton, Florida.
6. Sharma, A. K. and Sharma, A. (1999). Plant Chromosomes: Analysis, Manipulation and Engineering. Harwood Academic Publishers, Australia.
7. Buchanan B B, Gruisemm W, Jones R L (2015). Biochemistry and Molecular Biology of Plants, 2^{nd}edition, Wiley Blackwell, New Jersey.
8. Hopkins W G, Huner NPA (2009) Introduction to Plant Physiology, 4^{th} edition Wiley International edition, John Wiley & Sons, New York.
9. Taiz L, Zeiger E, Moller I M, Murph A (2015) Plant Physiology and Development, 6^{th}edition, Sinurer Associates Inc Publishers, Sunderland, Massachusetts.
10. Frank B. Salisbury and Cleon W. Ross (1985). Plant Physiology Wadsworth Publishing Company, Belmont, California.
11. Robert M. Devlin (3^{rd} edition) (1975) Plant Physiology Van Nostr and Reinhold Company, New York.
12. Walter Larcher (4^{th}edition) (2003) Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups Springer Verlag, Berlin.
13. Hans Mohr and Peter Schopfer (2010) Plant Physiology Springer Verlag, Berlin. Edwin Oxlade (2007) Plant Physiology: The Structure of Plants Explained Glmp Ltd, Abergele, United Kingdom.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><th colspan="7">PRACTICAL DISCIPLINE SPECIFIC CORE COURSE-DSCC4</th></tr>
<tr><th rowspan="2">COURSE</th><th rowspan="2">SEMESTER</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th colspan="3">PRACTICAL</th></tr>
<tr><th>Credits</th><th>CCE</th><th>SEE</th></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 PDSCC BOT104</td><td>PLANT DIVERSITY –I, PLANT TAXONOMY & CELL BIOLOGY</td><td>4
(120 hrs)</td><td>50 MARKS</td><td>50 MARKS</td></tr>
<tr><td>Course outcomes:</td><td colspan="6">Programme specific Learning and Course Outcomes:

After the completion of the course the students will be able:
• Perform basic microbiological techniques including isolation of microbes, serial dilution, bacterial culture, and Gram staining.
• Identify and study the structure and reproduction of representative algae and fungi using laboratory specimens and slides.
• Recognize plant diseases based on symptoms and demonstrate understanding through specimen/chart-based identification.
• Apply herbarium techniques, prepare digital herbarium sheets, and use flora for plant identification and classification.
• Conduct field studies, document plant diversity, and prepare scientific reports with geo tagged evidence.
• Perform basic cytological techniques including preparation of mitotic and meiotic stages and isolation of cell organelles.
• Analyze cell structures and chromosomes using microscopic slides, charts, and imaging techniques (SEM/TEM).
Pedagogy: Lab. works/ Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
<tr><th colspan="5">PRACTICALS</th><th colspan="2">NO. OF LECTURES
(120 hrs)</th></tr>
<tr><td colspan="5"><u>GROUP - A</u>
1. Isolation of microbes from soil through serial dilution.
2. Demonstrate the culture of bacteria.
3. Conduct a field visit to any one of the ecosystems rich in algae to experience algal diversity. Submit a report with photographs.
4. Thallus structure and reproduction: Ulva, Diatoms, Dictyota and Polysiphonia.
5. Ultrastructure of Virions (through chart).
6. Gram staining - curd, root nodules.
7. Study of following Fungi:
•Zygomycotina (Mucor),</td><td colspan="2">40</td></tr>
</table>

•Ascomycotina (*Aspergillus*) •Basidiomycotina (*Polyporus*) •Deuteromycotina (*Colletotrichum*) 8. Study of following Plant diseases: •Viral (Potato leaf roll-chart) •Bacterial blight of Paddy •Tikka disease in Groundnut	
<u>GROUP- B</u> 1. Visit a recognized herbarium, practice herbarium technique 2. Methods of identification of plants and preparation of at least 15 Standard herbarium sheets. 3. Study of genera from Families as per Theory Syllabus. 4. Identify the genus and species of given plant specimens with the help of standard Flora. 5. To prepare Dichotomous key with the help of given specimens. 6. Conduct field work for a period of not less than 5 days to familiarize plants under the guidance of faculties and submit a field report with geotagged photos.	**40**
<u>GROUP - C</u> 1. Isolation of Chloroplast by centrifugation. 2. Isolation of mitochondria by ultracentrifugation. 3. Temporary stained preparation of Mitosis / Meiosis – Onion root tip, Ipomoea bud, Tradescantia bud, Aloe bud. 4. Study of Giant chromosomes from Salivary glands of Chyronomous larva (Polytene)/Chart. 5. Salivary glands of Drosophila (Lampbrush) - Chart. 6. Study of various cell organelles (as per syllabus) through permanent slide/charts/models. 7. Study of Karyotype in plant cells. 8. Demonstration of SEM and TEM - photograph.	**40**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
(Effective from June 2026-27 UNDER NEP-2020)
M. Sc.: BOTANY Practical: SEMESTER-I
PLANT DIVERSITY –I , PLANT TAXONOMY& CELL BIOLOGY
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE-DSCC4
SC2M26PDSCCBOT104

Date: **Time: 6 Hrs**
Place: **Total Marks: 50**

Instructions: Strictly follow the instructions given by examiner(s).

Q.1: Identify and Classify giving with suitable reasons of given Specimen "A" **05**

Q.2: Expose the reproductive organ from the given specimen "B". Prepare the Slide and draw neat and labeled diagram. Show your slide to the examiner. **05**

OR

Q.2: Expose and mount the given material "B" of plant pathogen. Prepare the slide and draw neat and labeled diagram. Show to the examiner. **05**

Q.3: Refer to the given specimens "C", and "D" to the respective families giving reasons including floral formula and floral diagram. **08**

Q.4: Identify the genus and species of given plant specimen "E" with the help of standard Flora. **05**

Q.5: Make a Temporary stained preparation of Mitosis / Meiosis from given material "F" and show your preparation to the examiner. **06**

Q.6: Spot – "G'. 'H' "I" and "J". **12**

Q.7: (A) Journal **03**
(B) Submission/Botanical Tour Report **03**
(C) Viva-voce **03**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><th colspan="8">MULTI DISCIPLINE COURSE-MDC1</th></tr>
<tr><th rowspan="2">COURSE</th><th rowspan="2">SEMESTER</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th rowspan="2">CREDITS</th><th rowspan="2">LECTURES</th><th colspan="2">THEORY</th></tr>
<tr><th>CCE</th><th>SEE</th></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 MDC BOT105</td><td>GENETICS</td><td>2</td><td>T=30hrs</td><td>25 Marks</td><td>25 Marks</td></tr>
<tr><td>Course outcomes:</td><td colspan="7">Programme specific Learning and Course Outcomes:
• Explain gene structure, genetic code, and mutations.
• Describe extra-chromosomal inheritance including chloroplast and mitochondrial genetics.
• Apply principles of Mendelian and non-Mendelian inheritance to solve genetic problems.
• Analyze chromosomal basis of inheritance including sex determination and chromosomal aberrations.
• Interpret linkage, crossing over, and construct basic genetic maps using test cross and chi-square analysis.
Pedagogy: Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</td></tr>
</table>

<table>
<tr><th>THEORY UNIT</th><th>TOPIC</th><th>NO. OF LECTURES (30hrs)</th></tr>
<tr><td>Unit 1</td><td>Genetics – I
• Gene structure: Gene vs allele, fine structure of gene as cistron, recon and muton.
• Genetic code: Deciphering genetic code, properties of genetic code, initiation and termination codons, mutation and genetic code, wobble hypothesis, new genetic codes, overlapping and split genes.
• Extra chromosomal inheritance (maternal inheritance): Chloroplast genome (cp-DNA); Plastid inheritance in Mirabilis jalapa. Mitochondrial genome (mt-DNA); Mitochondrial inheritance in Zea mays (Male Sterility-Types, origin, induction and application).
• Petite in yeast and Porky in Neurospora. Comparison between Cp-DNA and Mt-DNA.</td><td>15</td></tr>
</table>

Unit 2	**Genetics - II**	15
	• Mendalian (mono & Di-hybridization) and Non-mendelian genetics (9:6:1), Epistasis (9:3:4 & 12:3:1), Polygenic inheritance (characteristics and Kernel colour in Wheat) and multiple alleles. • Chromosome theory and sex determination, chromosomal aberration. • Linkage and crossing over: Complete and incomplete linkage, Types of Crossing over, Three-point test cross and Chi square (X^2) test for segregation. • Linkage maps in Drosophila and chromosomal mapping.	

Suggested Readings:

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
3. Busch, H. and Rothblum, L. (1982). Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. (1998). Genetics: Principles and Analysis (4h edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. (1999). Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
7. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. (1997). Human Genetics: Concepts and Applications edition). WCB McGraw Hill, USA.
9. Russel, P. J. (1998). Genetics (5th edition). The Benjamin/Cummings Publishing Company Inc., USA.
10. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.

DETAILED SYLLABUS OF TWO-YEAR PG ONLY RESEACH RPROGRAMME IN BOTANY

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

MULTI DISCIPLINE COURSE-MDC2

COURSE	*SEMESTER*	*COURSE CODE*	*COURSE TITLE*	*PRACTICAL*		
				Credits	*CCE*	*SEE*
Master Degree Course	*M.Sc. SEM-I*	**SC2M26 PMDC BOT106**	**GENETICS**	**2 (60hrs)**	**25 Marks**	**25 Marks**

Course outcomes:

Programme specific Learning and Course Outcomes:
On completion of this course, the students will be able to:

- Demonstrate an understanding of plant ecology and phytogeography of India.
- Develop critical understanding on angiospermic plants.
- Demonstrate proficiency in the experimental techniques, methods of appropriate analysis of phytogeography and plant taxonomy.
- Apply theoretical knowledge in utilization, and report generation of economical and medicinal plants. Create awareness on conservation of medicinal plants and use of natural plant products as alternatives to synthetic products.

Pedagogy: Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.

	PRACTICALS	***NO. OF LECTURES* (60 hrs)**
Unit 1& 2	1. Induction of polyploidy using Colchicine. 2. Study of permanent slides/ charts/ models/ photographs as per theory syllabus. 3. Solve the genetic problems based on topics covered in the theory syllabus.	**60**

Suggested Readings:

1. Atherly, A.G., Girton, J.R. and McDonald, J.F. (1999). The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
2. Burnham, C.R. (1962). Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
3. Busch, H. and Rothblum, L. (1982). Volume X. The Cell Nucleus rDNA Part A. Academic Press.
4. Hartl, D.L. and Jones, E.W. (1998). Genetics: Principles and Analysis (4h edition). Jones & Bartlett Publishers, Massachusetts, USA.
5. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York, London.
6. Karp, G. (1999). Cells and Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc., U.S.A.
7. Lewin, B. (2000). Gene VII. Oxford University Press, New York, USA.
8. Lewis, R. (1997). Human Genetics: Concepts and Applications edition). WCB McGraw Hill, USA.
9. Russel, P. J. (1998). Genetics (5th edition). The Benjamin/Cummings Publishing Company Inc., USA.
10. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd edition). John Wiley & Sons Inc., USA.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
(Effective from June 2026-27 UNDER NEP-2020)
M. Sc.: BOTANY PRACTICAL: SEMESTER-I
(MULTI DISCIPLINE COURSES)
GENETICS
SC2M26PMDCBOT106

Date: **Time: 03:00Hrs**

Place: **Total Marks: 25**

Q.1: **Make a temporary stained preparation of Giant chromosomes/Polyploidy from given material 'A' and show your preparation to the examiner.** **04**

Q.2: **Solve and conclude the problems from genetics.** **09**
B. Polygenic inheritance
C. Three-point test cross
D. Chi square (X^2) test

Q.3: Comment upon the given spots/ Photographs/ Diagrams/ Models/ Charts. **06**
E. Gene structure/Genetic code
F. Extra chromosomal inheritance/ Male Sterility in *Zea mays*

Q.4: **(a) Journal** **03**
(b) Viva-voce **03**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2026-27 UNDER NEP-2020)

<table>
<tr><th colspan="8">VALUE ADDED COURSE-VAC</th></tr>
<tr><th rowspan="2">COURSE</th><th rowspan="2">SEMESTER</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th rowspan="2">Credits</th><th rowspan="2">Lectures</th><th colspan="2">THEORY</th></tr>
<tr><th>CCE</th><th>SEE</th></tr>
<tr><td>Master Degree Course</td><td>M.Sc. SEM-I</td><td>SC2M26 VAC BOT107</td><td>BIOFERTILIZER TECHNOLOGY</td><td>2</td><td>T=30hrs</td><td>25 Marks</td><td>25 Marks</td></tr>
<tr><td>Course outcomes</td><td colspan="7">Programme specific Learning and Course Outcomes:
1.This program will help students develop knowledge in bio fertilizer technology
2.This program will help students acquire laboratory, microscopy, and bio fertilizer skills. This program will help students build scientific, ethical, and professional competencies in Botany.
Pedagogy: Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.</td></tr>
<tr><th>THEORY UNIT</th><th colspan="6">TOPIC</th><th>NO. OF LECTURES (30hrs)</th></tr>
<tr><td>Unit 1</td><td colspan="6">• Biofertilizers: Definition, types and applications in agriculture.
• Characteristics of biofertilizers: Rhizobium, Azotobacter, phosphate-solubilizing microorganisms (PSMs), cyanobacteria, Azolla, mycorrhizae.
• Biological nitrogen fixation: Nitrogenase, substrates for nitrogenase, mechanism of action of nitrogenase, strategies to exclude oxygen and need to control hydrogen evolution, regulation of nitrogen fixation.</td><td>15</td></tr>
<tr><td>Unit 2</td><td colspan="6">• Rhizobium- legume symbiosis.
• Production technology: Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers.
• Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings, agronomical significance.</td><td>15</td></tr>
</table>

Suggested readings:

1. Gallon J R, Chaplin A E (1987) An Introduction to Nitrogen Fixation, Cassel Educational Limited, London.
2. Smith R J, Lea P J, Chaplin J R (1999) Nitrogen Fixation. In: Plant Biochemistry &Molecular Biology, 2ndedition, Lea P J, Lee good R C, John Wiley & Sons, New York, pp. 137-162.
3. Rai A N (1990) A Handbook of Symbiotic Cyanobacteria, CRC Press, BocaRaton, USA.
4. Postgate J R (1987) Nitrogen Fixation, 2 ndedition, Arnold, London.
5. Stacey G, Burris R H , Evans H J (1992) Biological Nitrogen Fixation, Chapman & Hall, NewYork.
6. Sprent J I, Sprent P (1990) Nitrogen Fixing Organisms: Pure and Applied Aspects. Chapman&Hall, London.
7. Kannaiyan S, Kumar K, Govindrajan K (2007) Biofertlizers Technology, Saujanya Books, NewDelhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN-384265

Faculty of Science

M. Sc. Microbiology
(2 yrs with course work and Research)

Syllabus/ scheme

Semester – 1 to 4

SEMESTER – I
(with course work and Research)

With effect from

June-2026

Date: 12/06/2026

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Microbiology) Syllabus 2026 (according toNEP-2020)	
Document code	**Syllabus MIC-2026**
Name of faculty	**Science**
Faculty code	**SCI**
Programme name	**M. Sc. Microbiology**
Programme code	**MIC**
Effective from	**June-2026**

The proposed new structure for M. Sc. Course (2 years with coursework and Research) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMMEOBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Microbiology as a basic science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Microbiology with different specializations.
3. To facilitate higher education & research in Microbiology.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in applied branches of Microbiology.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMMEOUTCOMES

1. The programme also works across related majors within the M.Sc. Microbiology.
2. To understand complex microbial physiology, immunology, Bioprocess, Microbes and their role in various environments and potential applications of microbes.
3. For instance, if you major in Microbiology, you can also still take courses from across the other complementary.
4. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as pharmaceutical sector, medical laboratories, agriculture, environmental management, biotechnology as well as teaching and research.
5. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
6. Understand the applications of microbial techniques to various fields of biology.
7. When you graduate with a Master of Science (Microbiology) you will have learned how to work at a high level of academic achievement.
8. Work to deadlines under pressure and communicate effectively.

M. Sc. Semester I (Microbiology)

M. Sc. with course work and Research								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSC CMIC101	Environmental Microbiology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSC CMIC102	Recombinant DNA Technology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSC CMIC103	Food Microbiology	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSC CMIC104	Practical (Environmental Microbiology, Recombinant DNA Technology, Food Microbiology)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MD CMIC105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course	SC2M26PM DCMIC106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VA CMIC107	Drug Discovery and Clinical Research	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

(with course work and Research)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME: M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE:
SC2M26DSCCMIC101
ENVIRONMENTAL MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives:

1. To understand major environmental pollution issues and possible solutions through knowledge of microbiology.
2. To understand biogeochemical cycling of essential elements and its implications.
3. To understand physiological and molecular adaptations in extremophiles and their possible biotechnological applications,
4. To understand various beneficial plant- microbes interactions and their importance in agriculture.
5. To learn various experimental approaches for detection and quantification of microbes in environment. 6. To understand fundamental aspects of microbial ecology

Course Outcome:

1. Having completed this course, the learner will be able to
2. Gain awareness about different Types of Environmental Pollution and Related Issues
3. Understand and appreciate crucial role of microbes in various biogeochemical cycles.
4. Learn different methods for detection of microbes from various environments and their characterization.
5. Understand fundamental aspects of microbial ecology and become familiar with current research in environmental microbiology
6. Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Global environmental problems: Global warming, Ozone depletion, Acid rain • Water pollution: Sources and types, Physical, chemical and biological pollution of water. Eutrophication and its control. Microbial Indicators of water pollution • Biodeterioration of wood and metals: Role of micro-organisms, mechanisms and control.	**1**	**15**

2	**Unit-2**	• Biogeochemical cycles: Cabron, Nitrogen, Sulphur , Iron and Phosphorous cycles. • Detrimental effects of diverted biogeochemical cycles: acid mine drainage, nitrous oxide emission, nitrate pollution of ground water • Biological Nitrogen Fixation in detail: Asymbiotic, symbiotic and associative nitrogen fixation. Structure, function and genetic regulation of nitrogenases.	**1**	**15**
3	**Unit-3**	• Microorganisms in extreme environments: Characteristics of extreme environments ,Microbial diversity, habitat and adaptive strategies of thermophiles and hyperthermophiles, psychrophiles and psychrotrophs, halophiles, acidophiles and alkalophiles. Biotechnological applications of extremophiles • Methods to study microorganisms in environment: Detection of microbial populations: Phenotypic detection, Lipid profile analysis, molecular detection. • Determination of microbial biomass: Biochemical assays, physiological approaches. Physiological methods to study microbial activity	**1**	**15**
4	**Unit-4**	• Microbial communities and ecosystems: Microbial community dynamics, Structure of microbial communities, Ecosystems,Structure and function of some microbial communities in nature. • Beneficial Interactions between microorganisms and plant: Mycorrhizae, Symbiotic nitrogen fixing associations between rhizobia and legumes, Anabaena and Azolla, Plant growth promoting rhizobacteria • Transport / Mobility of microorganisms in soil and subsurface: Factors affecting transport, Novel approaches to facilitate microbial transport	**1**	**15**
	Suggested References: 1. Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P. Gerba. 2. Comprehensive Biotechnology Vol-4, Murray Moo Young. 3. Biotechnology- Rehm and Reid. 4. Microbial Ecology: Fundamentals and Applications- Atlas & Bartha, fourth edition, Pearson Education. 5. Environmental science, B. J. Nebel and R. T. Wright. 6. The prokaryotes- 3 rd edition, volume 2 **7.** Brock Biology of microorganisms by Madigan, Martinko, Dunlap, and Clark			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC102

RECOMBINANT DNA TECHNOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objective:
- To understand the basic tools and techniques used for manipulation of DNA
- To become familiar with the strategies for production of transgenic organisms
- To learn applications of genetic engineering in agriculture, industry and medicine

Course Outcome:
- Having completed this course, the learner will be able to
- explain different steps involved in gene cloning, different enzymes available and how to choose an enzyme for a particular application in genetic engineering.
- describe salient features of different vectors available, their design and strategies to be applied for cloning and selection of recombinants.
- explain details of preparation of genomic and cDNA libraries as well as discuss various strategies for screening of recombinant clones.
- explain the PCR and its variants in detail along with their applications. Students will be able to design PCR primers and reaction parameters.
- describe different types of molecular markers and their applications in detail.
- explain various DNA sequencing techniques and their applications in detail.

Sr. No			Credit	Hr.
1	Unit-1	• Concept and importance of Genetic Engineering • General strategies and Steps involved in gene cloning: Extraction and purification of DNA and RNA from bacteria, virus, plant and animal cells • Physical and enzymatic methods for cutting DNA; Salient features of different enzymes used in R-DNA technology • Introduction of DNA into host cells; screening and selection methods for recombinant clones.	1	15

2	**Unit-2**	• Basic properties and cloning strategies for vectors derived from Plasmids, bacteriophages and their chimeric vectors, YAC, BAC, HAC/MAC and viral vectors for Plant and animal cells. • Salient features of expression vectors for heterologous expression in E. coli, Yeast, insect and mammalian system. • Shuttle vectors and gene trapping vectors. Vector design and modification strategies; chemical synthesis of oligonucleotides.	**1**	**15**
3	**Unit-3**	• DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. • DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. • Site directed mutagenesis: Methods and applications. • Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs. Construction genomic and cDNA libraries	**1**	**15**
4	**Unit-4**	• Applications of Genetic engineering in improvement of plants, animals and microbes; Gene editing and its applications; • Metagenomics andMetabolic engineering; Gene therapy • Restriction and regulations for the release of GMOs; Biosafety and levels of Physical and Biological containment • The Indian Guidelines for release and use of GM organisms.	**1**	**15**
	Suggested Reference 1. Principles of Gene Manipulation and Genomics" by Sandy B Primrose and Richard Twyman **2.** Genetic Engineering by Smita Rastogi and Neelam Pathak **3.** Gene cloning: An introduction. T. A. Brown			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC103

FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objective:

1. To understand the basic principle of food preservation
2. To become familiar with the strategies for detection of food spoilage and characterization.
3. To learn applications of microbes in food industries

Course Outcome:

After thorough understanding of the content student will be able toexplain:

1. Get acquainted with the food microbes and various techniques of food preservation
2. Develop understanding of spoilage and its management
3. Acquire experimental knowhow of some of the industrial important microbes used for product development

Sr. No			Credit	Hr.
1	Unit-1	• Food as substrate for microorganisms: Microorganisms important in food microbiology -Molds, Yeasts and Bacteria-General characteristics-classification and importance. • Principles of food preservation: Asepsis - Removal of microorganisms, (anaerobic conditions, high temperature, low temperature, drying,). • Factors influencing microbial growth in food - Extrinsic and intrinsic factors; • Chemical preservatives and Food additives. Canning, processing for Heat treatment-D,Z, and F values and working out treatment parameters.	1	15
2	Unit-2	• Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products- Fish and sea foods-poultry • Spoilage of Canned foods. • Detection of spoilage and characterization.	1	15

3	**Unit-3**	• Food-borne infections and intoxications: Bacterial and nonbacterial- with examples of infective and toxic types - Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia; Nematodes, protozoa, algae, fungi and viruses. • Foodborne outbreaks-laboratory testing procedures; Prevention Measures • Food sanitation in manufacture and retail trade; Food control agencies and its regulations, • Plant sanitation-Employee's Health standards-waste treatment-disposal quality control.	**1**	**15**
4	**Unit-4**	• Food fermentations: bread, cheese, vinegar. fermented vegetables, fermented dairy products; • Experimental and Industrial production methods. Spoilage and defects of fermented dairy products- oriental Fermented foods, their quality standards and control. • Food produced by Microbes: Fermented foods, microbial cells as food (single cell proteins) - mushroom cultivation. • Genetically modified foods.		
		Suggested Reference: • Adams M.R. and Moss M.O (1995) Food Microbiology. Royal Society of Chemistry Publication, Cambridge. • Frazier WC and Westhoff Dc (1988). Food Microbiology. Tata McGraw Hill Publishing Company Ltd, New Delhi. • Stanbury, PR, Whitekar, A and Hall, S.J (1995) Principles of Fermentation Technology. 2nd Edition. Pergamon Press. • Banwart. GJ (1989) Basic Food Microbiology. CBS Publishers and Distributors, Delhi. • Hobbs BC and Roberts D. (1993) Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London. • Robinson RK., (1990) Dairy Microbiology. Elsevier Applied Sciences, London.		

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCMIC104

ENVIRONEMNTAL MICROBIOLOGY, RECOMBINANT DNA TECHNOLLGY, FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. Microbiological analysis of drinking water (Detection and enumeration of coliforms, Fecal coliform MPN test, Detection of E. coli, Differentiation of coliforms)
2. Detection and enumeration of fecal Streptococcus and Enterococcus groups from recreational water
3. Oxidation of sulphur in soil
4. Demonstration of Nitrification in soil and its inhibition
5. Isolation of sulphur oxidizing bacteria from soil 13. Isolation of phosphate solubilizing microorganisms from soil
6. Restriction Digestion
7. Restriction Mapping
8. Ligation
9. Cloning of a gene in plasmid vector
10. Amplification of a desired fragment by PCR
11. RFLP
12. RAPD
13. Expression of a Recombinant Protein
14. Isolation of Lactobacilli from curd or milk sample
15. Detection of number of bacteria in milk by SPC
16. Determination of quality of milk sample by methylene blue reductase test (MBRT)
17. Microbiological examination of different food samples
18. Production of Sauerkraut by microorganisms
19. Determination of antibacterial activity of lactic acid bacteria using agar well diffusion method.
20. Statutory, recommended and supplementary tests for microbiological analysis of various foods: Baby foods, canned foods, milk and dairy products, eggs, meat, vegetables, fruits, cereals, surfaces, containers and water.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCMIC105

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit -2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Program Outcome:

1. This program will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This program will help students acquire laboratory, microscopy, and aquaculture skills.
3. This program will help students apply research design, data analysis, and scientific methods.
4. This program will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able toexplain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student’s t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi	1	15

2	**Unit-2**	• Introduction to research methodology, type of research, research method vs methodology. • Research process, type of sampling design, and methods of data collection. • Scientific deliveries and communications: writing research proposal, paper, thesis, and report. • Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. • Publication processes, review processes and significance of scientific communications.	**1**	**15**

References:

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. MICROBIOLOGY SEMESTERI
PROGRAM CODE: MIC
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCMIC106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit -2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

<u>List of Practicals</u>

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student’s t testand single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. MICROBIOLOGY SEMESTERI
PROGRAM CODE: MIC
VALUE ADDED COURSE CODE: SC2M26VACMIC107

DRUG DISCOVERY AND CLINICAL RESEARCH

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	**(02 Period/Week)**	**Internal-25Marks**	**External-25Marks**	**External 25Marks Internal 25Marks**

Course objective: 1. To develop knowledge of drug designing approaches. 2. To generate practical approach for molecular docking studies 3. To develop attention towards procedures of clinical trials
Course Outcome: After thorough understanding of the content student will be able to explain: 1. About drug discovery and designing strategies. 2. How protein structure prediction is performed 3. How docking is important for drug discovery 4. And understand clinical trials

Unit	Content	Credit	Hours
I	• Drug Discovery process and Drug designing: Overview of Drug discovery process, Cost of Drug development, • Protein Structure Prediction: Comparative and Homology modeling, The Critical Assessment of protein Structure Prediction (CASP), Superposition of proteins using different tools, RMSD, Presentation of protein conformations, Hydrophobicity factor, Shape complementary. • Molecular Docking Studies: Structure-based De Novo Ligand design, Drug Discovery – QSAR, Different types of docking approaches (Structure-based, Ligand-based), Mode of interaction studies, Pharmacophoreprediction based on the docking analysis.	01	15
II	• Clinical research: Scope of Clinical Research, Good Clinical Practices (GCP), History of clinical research, Types of clinical trials, clinical trials Phases, Special Clinical Trials, Medical Devices Trials, • Un-anticipated risk in clinical research. SOP in Clinical Trials, Clinical Trial Monitoring, Role of CRA,QA and QC in Clinical Trials, CRF Design.	01	15
	Suggested reference • Susanna Wu-Pong, Yongyut Rojanasakul, and Joseph Robinson (2006): Biopharmaceutical Drug Design and Development. • Fundamentals of Clinical Trials By Lawrence M. Friedman, Curt D. Furberg, David DeMets • Management of data in clinical trials by Eleanor McFadden		

	• Principle and Practice of Clinical Research by John I. Gallin, Frederick P Ognibene • Clinical Data Management By Richard K. Rondel, Sheila A. Varley, Colin F. Webb • Principles and Practice of Clinical Research By John A Gallin	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL DISCIPLINE SPECIFIC CORE COURSECODE: SC2M26PDSCCMIC104

ENVIRONEMNTAL MICROBIOLOGY, RECOMBINANT DNA TECHNOLLGY AND FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Do as directed	**10**
Q2		Do as directed	**10**
Q3		Do as directed	**05**
Q4		Do as directed.	**05**
Q5	**a**	Spotting	**10**
	b	Journal	**05**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE
CODE: SC2M26PMDCMIC106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Do as directed	**05**
Q2		Do as directed	**05**
Q3		Do as directed	**05**
Q4		Spotting / Do as directed	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN-384265

Faculty of Science

M. Sc. Microbiology
(2 yrs with course work)
Syllabus/ scheme
Semester – 1 to 4

SEMESTER – I
(with course work)

With effect from

June-2026

Date: 12/06/2026

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Microbiology) Syllabus 2026 (according toNEP-2020)	
Document code	Syllabus MIC-2026
Name of faculty	Science
Faculty code	SCI
Programme name	M. Sc. Microbiology
Programme code	MIC
Effective from	June-2026

The proposed new structure for M. Sc. Course (2 years with coursework) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMMEOBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Microbiology as a basic science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Microbiology with different specializations.
3. To facilitate higher education & research in Microbiology.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in applied branches of Microbiology.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMMEOUTCOMES

1. The programme also works across related majors within the M.Sc. Microbiology.
2. To understand complex microbial physiology, immunology, Bioprocess, Microbes and their role in various environments and potential applications of microbes.
3. For instance, if you major in Microbiology, you can also still take courses from across the other complementary.
4. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as pharmaceutical sector, medical laboratories, agriculture, environmental management, biotechnology as well as teaching and research.
5. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
6. Understand the applications of microbial techniques to various fields of biology.
7. When you graduate with a Master of Science (Microbiology) you will have learned how to work at a high level of academic achievement.
8. Work to deadlines under pressure and communicate effectively.

M. Sc. Semester I (Microbiology)

M. Sc. with course work								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSC CMIC101	Environmental Microbiology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSC CMIC102	Recombinant DNA Technology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSC CMIC103	Food Microbiology	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSC CMIC104	Practical (Environmental Microbiology, Recombinant DNA Technology, Food Microbiology)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MD CMIC105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course	SC2M26PM DCMIC106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VA CMIC107	Drug Discovery and Clinical Research	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

(with course work)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME: M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC101

ENVIRONMENTAL MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives:
1. To understand major environmental pollution issues and possible solutions through knowledge of microbiology.
2. To understand biogeochemical cycling of essential elements and its implications.
3. To understand physiological and molecular adaptations in extremophiles and their possible biotechnological applications,
4. To understand various beneficial plant- microbes interactions and their importance in agriculture.
5. To learn various experimental approaches for detection and quantification of microbes in environment. 6. To understand fundamental aspects of microbial ecology

Course Outcome:
1. Having completed this course, the learner will be able to
2. Gain awareness about different Types of Environmental Pollution and Related Issues
3. Understand and appreciate crucial role of microbes in various biogeochemical cycles.
4. Learn different methods for detection of microbes from various environments and their characterization.
5. Understand fundamental aspects of microbial ecology and become familiar with current research in environmental microbiology
6. Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Global environmental problems: Global warming, Ozone depletion, Acid rain • Water pollution: Sources and types, Physical, chemical and biological pollution of water. Eutrophication and its control. Microbial Indicators of water pollution • Biodeterioration of wood and metals: Role of micro-organisms, mechanisms and control.	**1**	**15**

2	**Unit-2**	• Biogeochemical cycles: Cabron, Nitrogen, Sulphur , Iron and Phosphorous cycles. • Detrimental effects of diverted biogeochemical cycles: acid mine drainage, nitrous oxide emission, nitrate pollution of ground water • Biological Nitrogen Fixation in detail: Asymbiotic, symbiotic and associative nitrogen fixation. Structure, function and genetic regulation of nitrogenases.	**1**	**15**
3	**Unit-3**	• Microorganisms in extreme environments: Characteristics of extreme environments ,Microbial diversity, habitat and adaptive strategies of thermophiles and hyperthermophiles, psychrophiles and psychrotrophs, halophiles, acidophiles and alkalophiles. Biotechnological applications of extremophiles • Methods to study microorganisms in environment: Detection of microbial populations: Phenotypic detection, Lipid profile analysis, molecular detection. • Determination of microbial biomass: Biochemical assays, physiological approaches. Physiological methods to study microbial activity	**1**	**15**
4	**Unit-4**	• Microbial communities and ecosystems: Microbial community dynamics, Structure of microbial communities, Ecosystems,Structure and function of some microbial communities in nature. • Beneficial Interactions between microorganisms and plant: Mycorrhizae, Symbiotic nitrogen fixing associations between rhizobia and legumes, Anabaena and Azolla, Plant growth promoting rhizobacteria • Transport / Mobility of microorganisms in soil and subsurface: Factors affecting transport, Novel approaches to facilitate microbial transport	**1**	**15**
	Suggested References: 1. Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P. Gerba. 2. Comprehensive Biotechnology Vol-4, Murray Moo Young. 3. Biotechnology- Rehm and Reid. 4. Microbial Ecology: Fundamentals and Applications- Atlas & Bartha, fourth edition, Pearson Education. 5. Environmental science, B. J. Nebel and R. T. Wright. 6. The prokaryotes- 3 rd edition, volume 2 **7.** Brock Biology of microorganisms by Madigan, Martinko, Dunlap, and Clark			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC102

RECOMBINANT DNA TECHNOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objective:

- To understand the basic tools and techniques used for manipulation of DNA
- To become familiar with the strategies for production of transgenic organisms
- To learn applications of genetic engineering in agriculture, industry and medicine

Course Outcome:

- Having completed this course, the learner will be able to
- explain different steps involved in gene cloning, different enzymes available and how to choose an enzyme for a particular application in genetic engineering.
- describe salient features of different vectors available, their design and strategies to be applied for cloning and selection of recombinants.
- explain details of preparation of genomic and cDNA libraries as well as discuss various strategies for screening of recombinant clones.
- explain the PCR and its variants in detail along with their applications. Students will be able to design PCR primers and reaction parameters.
- describe different types of molecular markers and their applications in detail.
- explain various DNA sequencing techniques and their applications in detail.

Sr. No			Credit	Hr.
1	Unit-1	• Concept and importance of Genetic Engineering • General strategies and Steps involved in gene cloning: Extraction and purification of DNA and RNA from bacteria, virus, plant and animal cells • Physical and enzymatic methods for cutting DNA; Salient features of different enzymes used in R-DNA technology • Introduction of DNA into host cells; screening and selection methods for recombinant clones.	1	15

2	**Unit-2**	• Basic properties and cloning strategies for vectors derived from Plasmids, bacteriophages and their chimeric vectors, YAC, BAC, HAC/MAC and viral vectors for Plant and animal cells. • Salient features of expression vectors for heterologous expression in E. coli, Yeast, insect and mammalian system. • Shuttle vectors and gene trapping vectors. Vector design and modification strategies; chemical synthesis of oligonucleotides.	**1**	**15**
3	**Unit-3**	• DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. • DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. • Site directed mutagenesis: Methods and applications. • Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs. Construction genomic and cDNA libraries	**1**	**15**
4	**Unit-4**	• Applications of Genetic engineering in improvement of plants, animals and microbes; Gene editing and its applications; • Metagenomics andMetabolic engineering; Gene therapy • Restriction and regulations for the release of GMOs; Biosafety and levels of Physical and Biological containment • The Indian Guidelines for release and use of GM organisms.	**1**	**15**
	Suggested Reference 1. Principles of Gene Manipulation and Genomics" by Sandy B Primrose and Richard Twyman **2.** Genetic Engineering by Smita Rastogi and Neelam Pathak **3.** Gene cloning: An introduction. T. A. Brown			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC103

FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objective:
1. To understand the basic principle of food preservation
2. To become familiar with the strategies for detection of food spoilage and characterization.
3. To learn applications of microbes in food industries

Course Outcome:

After thorough understanding of the content student will be able toexplain:
1. Get acquainted with the food microbes and various techniques of food preservation
2. Develop understanding of spoilage and its management
3. Acquire experimental knowhow of some of the industrial important microbes used for product development

Sr. No			Credit	Hr.
1	Unit-1	• Food as substrate for microorganisms: Microorganisms important in food microbiology -Molds, Yeasts and Bacteria- General characteristics-classification and importance. • Principles of food preservation: Asepsis - Removal of microorganisms, (anaerobic conditions, high temperature, low temperature, drying,). • Factors influencing microbial growth in food - Extrinsic and intrinsic factors; • Chemical preservatives and Food additives. Canning, processing for Heat treatment-D,Z, and F values and working out treatment parameters.	1	15
2	Unit-2	• Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products- Fish and sea foods-poultry • Spoilage of Canned foods. • Detection of spoilage and characterization.	1	15

3	**Unit-3**	• Food-borne infections and intoxications: Bacterial and nonbacterial- with examples of infective and toxic types - Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia; Nematodes, protozoa, algae, fungi and viruses. • Foodborne outbreaks-laboratory testing procedures; Prevention Measures • Food sanitation in manufacture and retail trade; Food control agencies and its regulations, • Plant sanitation-Employee's Health standards-waste treatment-disposal quality control.	**1**	**15**
4	**Unit-4**	• Food fermentations: bread, cheese, vinegar. fermented vegetables, fermented dairy products; • Experimental and Industrial production methods. Spoilage and defects of fermented dairy products- oriental Fermented foods, their quality standards and control. • Food produced by Microbes: Fermented foods, microbial cells as food (single cell proteins) - mushroom cultivation. • Genetically modified foods.		
	Suggested Reference: • Adams M.R. and Moss M.O (1995) Food Microbiology. Royal Society of Chemistry Publication, Cambridge. • Frazier WC and Westhoff Dc (1988). Food Microbiology. Tata McGraw Hill Publishing Company Ltd, New Delhi. • Stanbury, PR, Whitekar, A and Hall, S.J (1995) Principles of Fermentation Technology. 2nd Edition. Pergamon Press. • Banwart. GJ (1989) Basic Food Microbiology. CBS Publishers and Distributors, Delhi. • Hobbs BC and Roberts D. (1993) Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London. • Robinson RK., (1990) Dairy Microbiology. Elsevier Applied Sciences, London.			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCMIC104

ENVIRONEMNTAL MICROBIOLOGY, RECOMBINANT DNA TECHNOLLGY, FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. Microbiological analysis of drinking water (Detection and enumeration of coliforms, Fecal coliform MPN test, Detection of E. coli, Differentiation of coliforms)
2. Detection and enumeration of fecal Streptococcus and Enterococcus groups from recreational water
3. Oxidation of sulphur in soil
4. Demonstration of Nitrification in soil and its inhibition
5. Isolation of sulphur oxidizing bacteria from soil 13. Isolation of phosphate solubilizing microorganisms from soil
6. Restriction Digestion
7. Restriction Mapping
8. Ligation
9. Cloning of a gene in plasmid vector
10. Amplification of a desired fragment by PCR
11. RFLP
12. RAPD
13. Expression of a Recombinant Protein
14. Isolation of Lactobacilli from curd or milk sample
15. Detection of number of bacteria in milk by SPC
16. Determination of quality of milk sample by methylene blue reductase test (MBRT)
17. Microbiological examination of different food samples
18. Production of Sauerkraut by microorganisms
19. Determination of antibacterial activity of lactic acid bacteria using agar well diffusion method.
20. Statutory, recommended and supplementary tests for microbiological analysis of various foods: Baby foods, canned foods, milk and dairy products, eggs, meat, vegetables, fruits, cereals, surfaces, containers and water.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCMIC105

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit -2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Program Outcome:

1. This program will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This program will help students acquire laboratory, microscopy, and aquaculture skills.
3. This program will help students apply research design, data analysis, and scientific methods.
4. This program will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student's t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi	1	15

2	**Unit-2**	• Introduction to research methodology, type of research, research method vs methodology. • Research process, type of sampling design, and methods of data collection. • Scientific deliveries and communications: writing research proposal, paper, thesis, and report. • Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. • Publication processes, review processes and significance of scientific communications.	**1**	**15**

References:

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCMIC106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit -2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student's t testand single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY,
PATAN COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC
VALUE ADDED COURSE CODE: SC2M26VACMIC107

DRUG DISCOVERY AND CLINICAL RESEARCH

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits- 02	(02 Period/Week)	Internal- 25 Marks	External- 25 Marks	External 25 Marks Internal 25 Marks

Course objective: 1. To develop knowledge of drug designing approaches. 2. To generate practical approach for molecular docking studies 3. To develop attention towards procedures of clinical trials
Course Outcome: After thorough understanding of the content student will be able toexplain: 1. About drug discovery and designing strategies. 2. How protein structure prediction is performed 3. How docking is important for drug discovery 4. And understand clinical trials

Unit	Content	Credit	Hours
I	• Drug Discovery process and Drug designing: Overview of Drug discovery process, Cost of Drug development, • Protein Structure Prediction: Comparative and Homology modeling, The Critical Assessment of protein Structure Prediction (CASP), Superposition of proteins using different tools, RMSD, Presentation of protein conformations, Hydrophobicity factor, Shape complementary. • Molecular Docking Studies: Structure-based De Novo Ligand design, Drug Discovery – QSAR, Different types of docking approaches (Structure-based, Ligand-based), Mode of interaction studies, Pharmacophoreprediction based on the docking analysis.	01	15
II	• Clinical research: Scope of Clinical Research, Good Clinical Practices (GCP), History of clinical research, Types of clinical trials, clinical trials Phases, Special Clinical Trials, Medical Devices Trials, • Un-anticipated risk in clinical research. SOP in Clinical Trials, Clinical Trial Monitoring, Role of CRA,QA and QC in Clinical Trials, CRF Design.	01	15
	Suggested reference • Susanna Wu-Pong, Yongyut Rojanasakul, and Joseph Robinson (2006): Biopharmaceutical Drug Design and Development. • Fundamentals of Clinical Trials By Lawrence M. Friedman, Curt D. Furberg, David DeMets • Management of data in clinical trials by Eleanor McFadden		

	• Principle and Practice of Clinical Research by John I. Gallin, Frederick P Ognibene • Clinical Data Management By Richard K. Rondel, Sheila A. Varley, Colin F. Webb • Principles and Practice of Clinical Research By John A Gallin	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL DISCIPLINE SPECIFIC CORE COURSECODE: SC2M26PDSCCMIC104

ENVIRONEMNTAL MICROBIOLOGY, RECOMBINANT DNA TECHNOLLGY AND FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Do as directed	**10**
Q2		Do as directed	**10**
Q3		Do as directed	**05**
Q4		Do as directed.	**05**
Q5	**a**	Spotting	**10**
	b	Journal	**05**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I PROGRAM CODE: MIC

PRACTICALMULTI-DISCIPLINE SPECIFIC CORECOURSECODE: SC2M26PMDCMIC106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Do as directed	**05**
Q2		Do as directed	**05**
Q3		Do as directed	**05**
Q4		Spotting / Do as directed	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN-384265

Faculty of Science

M. Sc. Microbiology
(2 yrs with Research)

Syllabus/ scheme

Semester – 1 to 4

SEMESTER – I
(with Research)

With effect from

June-2026

Date: 12/06/2026

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Microbiology) Syllabus 2026 (according toNEP-2020)	
Document code	Syllabus MIC-2026
Name of faculty	Science
Faculty code	SCI
Programme name	M. Sc. Microbiology
Programme code	MIC
Effective from	June-2026

The proposed new structure for M. Sc. Course (2 years with Research) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMMEOBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Microbiology as a basic science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Microbiology with different specializations.
3. To facilitate higher education & research in Microbiology.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in applied branches of Microbiology.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMMEOUTCOMES

1. The programme also works across related majors within the M.Sc. Microbiology.
2. To understand complex microbial physiology, immunology, Bioprocess, Microbes and their role in various environments and potential applications of microbes.
3. For instance, if you major in Microbiology, you can also still take courses from across the other complementary.
4. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as pharmaceutical sector, medical laboratories, agriculture, environmental management, biotechnology as well as teaching and research.
5. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
6. Understand the applications of microbial techniques to various fields of biology.
7. When you graduate with a Master of Science (Microbiology) you will have learned how to work at a high level of academic achievement.
8. Work to deadlines under pressure and communicate effectively.

M. Sc. Semester I (Microbiology)

M. Sc. with Research								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSC CMIC101	Environmental Microbiology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSC CMIC102	Recombinant DNA Technology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSC CMIC103	Food Microbiology	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSC CMIC104	Practical (Environmental Microbiology, Recombinant DNA Technology, Food Microbiology)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MD CMIC105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course	SC2M26PM DCMIC106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VA CMIC107	Drug Discovery and Clinical Research	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

(with Research)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME: M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC101

ENVIRONMENTAL MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives:
1. To understand major environmental pollution issues and possible solutions through knowledge of microbiology.
2. To understand biogeochemical cycling of essential elements and its implications.
3. To understand physiological and molecular adaptations in extremophiles and their possible biotechnological applications,
4. To understand various beneficial plant- microbes interactions and their importance in agriculture.
5. To learn various experimental approaches for detection and quantification of microbes in environment. 6. To understand fundamental aspects of microbial ecology

Course Outcome:
1. Having completed this course, the learner will be able to
2. Gain awareness about different Types of Environmental Pollution and Related Issues
3. Understand and appreciate crucial role of microbes in various biogeochemical cycles.
4. Learn different methods for detection of microbes from various environments and their characterization.
5. Understand fundamental aspects of microbial ecology and become familiar with current research in environmental microbiology
6. Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Global environmental problems: Global warming, Ozone depletion, Acid rain • Water pollution: Sources and types, Physical, chemical and biological pollution of water. Eutrophication and its control. Microbial Indicators of water pollution • Biodeterioration of wood and metals: Role of micro-organisms, mechanisms and control.	**1**	**15**

2	**Unit-2**	• Biogeochemical cycles: Cabron, Nitrogen, Sulphur , Iron and Phosphorous cycles. • Detrimental effects of diverted biogeochemical cycles: acid mine drainage, nitrous oxide emission, nitrate pollution of ground water • Biological Nitrogen Fixation in detail: Asymbiotic, symbiotic and associative nitrogen fixation. Structure, function and genetic regulation of nitrogenases.	**1**	**15**
3	**Unit-3**	• Microorganisms in extreme environments: Characteristics of extreme environments, Microbial diversity, habitat and adaptive strategies of thermophiles and hyperthermophiles, psychrophiles and psychrotrophs, halophiles, acidophiles and alkalophiles. Biotechnological applications of extremophiles • Methods to study microorganisms in environment: Detection of microbial populations: Phenotypic detection, Lipid profile analysis, molecular detection. • Determination of microbial biomass: Biochemical assays, physiological approaches. Physiological methods to study microbial activity	**1**	**15**
4	**Unit-4**	• Microbial communities and ecosystems: Microbial community dynamics, Structure of microbial communities, Ecosystems,Structure and function of some microbial communities in nature. • Beneficial Interactions between microorganisms and plant: Mycorrhizae, Symbiotic nitrogen fixing associations between rhizobia and legumes, Anabaena and Azolla, Plant growth promoting rhizobacteria • Transport / Mobility of microorganisms in soil and subsurface: Factors affecting transport, Novel approaches to facilitate microbial transport	**1**	**15**
	Suggested References: 1. Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P. Gerba. 2. Comprehensive Biotechnology Vol-4, Murray Moo Young. 3. Biotechnology- Rehm and Reid. 4. Microbial Ecology: Fundamentals and Applications- Atlas & Bartha, fourth edition, Pearson Education. 5. Environmental science, B. J. Nebel and R. T. Wright. 6. The prokaryotes- 3 rd edition, volume 2 **7.** Brock Biology of microorganisms by Madigan, Martinko, Dunlap, and Clark			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC102

RECOMBINANT DNA TECHNOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objective:

- To understand the basic tools and techniques used for manipulation of DNA
- To become familiar with the strategies for production of transgenic organisms
- To learn applications of genetic engineering in agriculture, industry and medicine

Course Outcome:

- Having completed this course, the learner will be able to
- explain different steps involved in gene cloning, different enzymes available and how to choose an enzyme for a particular application in genetic engineering.
- describe salient features of different vectors available, their design and strategies to be applied for cloning and selection of recombinants.
- explain details of preparation of genomic and cDNA libraries as well as discuss various strategies for screening of recombinant clones.
- explain the PCR and its variants in detail along with their applications. Students will be able to design PCR primers and reaction parameters.
- describe different types of molecular markers and their applications in detail.
- explain various DNA sequencing techniques and their applications in detail.

Sr. No			Credit	Hr.
1	Unit-1	• Concept and importance of Genetic Engineering • General strategies and Steps involved in gene cloning: Extraction and purification of DNA and RNA from bacteria, virus, plant and animal cells • Physical and enzymatic methods for cutting DNA; Salient features of different enzymes used in R-DNA technology • Introduction of DNA into host cells; screening and selection methods for recombinant clones.	1	15

2	**Unit-2**	• Basic properties and cloning strategies for vectors derived from Plasmids, bacteriophages and their chimeric vectors, YAC, BAC, HAC/MAC and viral vectors for Plant and animal cells. • Salient features of expression vectors for heterologous expression in E. coli, Yeast, insect and mammalian system. • Shuttle vectors and gene trapping vectors. Vector design and modification strategies; chemical synthesis of oligonucleotides.	**1**	**15**
3	**Unit-3**	• DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. • DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. • Site directed mutagenesis: Methods and applications. • Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs. Construction genomic and cDNA libraries	**1**	**15**
4	**Unit-4**	• Applications of Genetic engineering in improvement of plants, animals and microbes; Gene editing and its applications; • Metagenomics andMetabolic engineering; Gene therapy • Restriction and regulations for the release of GMOs; Biosafety and levels of Physical and Biological containment • The Indian Guidelines for release and use of GM organisms.	**1**	**15**
	Suggested Reference 1. Principles of Gene Manipulation and Genomics" by Sandy B Primrose and Richard Twyman **2.** Genetic Engineering by Smita Rastogi and Neelam Pathak **3.** Gene cloning: An introduction. T. A. Brown			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCMIC103

FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits-04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objective:

1. To understand the basic principle of food preservation
2. To become familiar with the strategies for detection of food spoilage and characterization.
3. To learn applications of microbes in food industries

Course Outcome:

After thorough understanding of the content student will be able toexplain:

1. Get acquainted with the food microbes and various techniques of food preservation
2. Develop understanding of spoilage and its management
3. Acquire experimental knowhow of some of the industrial important microbes used for product development

Sr. No			Credit	Hr.
1	Unit-1	• Food as substrate for microorganisms: Microorganisms important in food microbiology -Molds, Yeasts and Bacteria-General characteristics-classification and importance. • Principles of food preservation: Asepsis - Removal of microorganisms, (anaerobic conditions, high temperature, low temperature, drying,). • Factors influencing microbial growth in food - Extrinsic and intrinsic factors; • Chemical preservatives and Food additives. Canning, processing for Heat treatment-D,Z, and F values and working out treatment parameters.	1	15
2	Unit-2	• Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products- Fish and sea foods-poultry • Spoilage of Canned foods. • Detection of spoilage and characterization.	1	15

3	**Unit-3**	• Food-borne infections and intoxications: Bacterial and nonbacterial- with examples of infective and toxic types - Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia; Nematodes, protozoa, algae, fungi and viruses. • Food borne outbreaks-laboratory testing procedures; Prevention Measures • Food sanitation in manufacture and retail trade; Food control agencies and its regulations, • Plant sanitation-Employee's Health standards-waste treatment-disposal quality control.	**1**	**15**
4	**Unit-4**	• Food fermentations: bread, cheese, vinegar. fermented vegetables, fermented dairy products; • Experimental and Industrial production methods. Spoilage and defects of fermented dairy products- oriental Fermented foods, their quality standards and control. • Food produced by Microbes: Fermented foods, microbial cells as food (single cell proteins) - mushroom cultivation. • Genetically modified foods.		
	Suggested Reference: • Adams M.R. and Moss M.O (1995) Food Microbiology. Royal Society of Chemistry Publication, Cambridge. • Frazier WC and Westhoff Dc (1988). Food Microbiology. Tata McGraw Hill Publishing Company Ltd, New Delhi. • Stanbury, PR, Whitekar, A and Hall, S.J (1995) Principles of Fermentation Technology. 2nd Edition. Pergamon Press. • Banwart. GJ (1989) Basic Food Microbiology. CBS Publishers and Distributors, Delhi. • Hobbs BC and Roberts D. (1993) Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London. • Robinson RK., (1990) Dairy Microbiology. Elsevier Applied Sciences, London.			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE:
SC2M26PDSCCMIC104

ENVIRONEMNTAL MICROBIOLOGY, RECOMBINANT DNA TECHNOLLGY, FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

<u>List of Practicals</u>

1. Microbiological analysis of drinking water (Detection and enumeration of coliforms, Fecal coliform MPN test, Detection of E. coli, Differentiation of coliforms)
2. Detection and enumeration of fecal Streptococcus and Enterococcus groups from recreational water
3. Oxidation of sulphur in soil
4. Demonstration of Nitrification in soil and its inhibition
5. Isolation of sulphur oxidizing bacteria from soil 13. Isolation of phosphate solubilizing microorganisms from soil
6. Restriction Digestion
7. Restriction Mapping
8. Ligation
9. Cloning of a gene in plasmid vector
10. Amplification of a desired fragment by PCR
11. RFLP
12. RAPD
13. Expression of a Recombinant Protein
14. Isolation of Lactobacilli from curd or milk sample
15. Detection of number of bacteria in milk by SPC
16. Determination of quality of milk sample by methylene blue reductase test (MBRT)
17. Microbiological examination of different food samples
18. Production of Sauerkraut by microorganisms
19. Determination of antibacterial activity of lactic acid bacteria using agar well diffusion method.
20. Statutory, recommended and supplementary tests for microbiological analysis of various foods: Baby foods, canned foods, milk and dairy products, eggs, meat, vegetables, fruits, cereals, surfaces, containers and water.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN COURSE NAME M. SC. MICROBIOLOGY SEMESTER I

PROGRAM CODE: MIC

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCMIC105

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit -2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Program Outcome:

1. This program will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This program will help students acquire laboratory, microscopy, and aquaculture skills.
3. This program will help students apply research design, data analysis, and scientific methods.
4. This program will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able toexplain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student's t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi	1	15

2	**Unit-2**	● Introduction to research methodology, type of research, research method vs methodology. ● Research process, type of sampling design, and methods of data collection. ● Scientific deliveries and communications: writing research proposal, paper, thesis, and report. ● Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. ● Publication processes, review processes and significance of scientific communications.	**1**	**15**

References:

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCMIC106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit -2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student’s t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. MICROBIOLOGY SEMESTER I PROGRAM CODE: MIC
VALUE ADDED COURSE CODE: SC2M26VACMIC107

DRUG DISCOVERY AND CLINICAL RESEARCH

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	(02 Period/Week)	Internal-25 Marks	External-25 Marks	External 25 Marks Internal 25 Marks

Course objective: 1. To develop knowledge of drug designing approaches. 2. To generate practical approach for molecular docking studies 3. To develop attention towards procedures of clinical trials
Course Outcome: After thorough understanding of the content student will be able to explain: 1. About drug discovery and designing strategies. 2. How protein structure prediction is performed 3. How docking is important for drug discovery 4. And understand clinical trials

Unit	Content	Credit	Hours
I	• Drug Discovery process and Drug designing: Overview of Drug discovery process, Cost of Drug development, • Protein Structure Prediction: Comparative and Homology modeling, The Critical Assessment of protein Structure Prediction (CASP), Superposition of proteins using different tools, RMSD, Presentation of protein conformations, Hydrophobicity factor, Shape complementary. • Molecular Docking Studies: Structure-based De Novo Ligand design, Drug Discovery – QSAR, Different types of docking approaches (Structure-based, Ligand-based), Mode of interaction studies, Pharmacophoreprediction based on the docking analysis.	01	15
II	• Clinical research: Scope of Clinical Research, Good Clinical Practices (GCP), History of clinical research, Types of clinical trials, clinical trials Phases, Special Clinical Trials, Medical Devices Trials, • Un-anticipated risk in clinical research. SOP in Clinical Trials, Clinical Trial Monitoring, Role of CRA, QA and QC in Clinical Trials, CRF Design.	01	15
	Suggested reference • Susanna Wu-Pong, Yongyut Rojanasakul, and Joseph Robinson (2006): Biopharmaceutical Drug Design and Development. • Fundamentals of Clinical Trials By Lawrence M. Friedman, Curt D. Furberg, David DeMets • Management of data in clinical trials by Eleanor McFadden		

	• Principle and Practice of Clinical Research by John I. Gallin, Frederick P Ognibene • Clinical Data Management By Richard K. Rondel, Sheila A. Varley, Colin F. Webb • Principles and Practice of Clinical Research By John A Gallin	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I
PROGRAM CODE: MIC
PRACTICAL DISCIPLINE SPECIFIC CORE COURSECODE: SC2M26PDSCCMIC104

ENVIRONEMNTAL MICROBIOLOGY, RECOMBINANT DNA TECHNOLLGY AND FOOD MICROBIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks:50**

Q1		Do as directed	**10**
Q2		Do as directed	**10**
Q3		Do as directed	**05**
Q4		Do as directed	**05**
Q5	**a**	Spotting	**10**
	b	Journal	**05**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. MICROBIOLOGY SEMESTER I PROGRAM CODE: MIC

PRACTICAL MULTI-DISCIPLINE SPECIFIC CORECOURSECODE: SC2M26PMDCMIC106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks:25**

Q1		Do as directed	**05**
Q2		Do as directed	**05**
Q3		Do as directed	**05**
Q4		Spotting / Do as directed	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN

M.Sc. Biotechnology Syllabus (New Education Policy-NEP-2023)

Document code	Syllabus Biotechnology NEP-2023
Name of faculty	Science
Faculty code	SCI
Programme name	Postgraduate(M.Sc.)
Subject	Biotechnology
Programme code	SCIPG106
Effective from	June-2026

Hemchandracharya North Gujarat University, Patan

M. Sc. Biotechnology Syllabus

(TWO YEAR)
(ONLY COURSE WORK PROGRAMME)

w.e.f.

from June 2026 under NEP 2023

The proposed new structure for M. Sc. Course (2 years with course work and research) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMMEOBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Biotechnology as an applied science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Biotechnology with different specializations.
3. To facilitate higher education & research in Biotechnology.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in applied branches of Biotechnology.
5. To inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. The programme also works across related majors within the M.Sc. Biotechnology.
2. To understand complex Plant Biotechnology, Animal Biotechnology, immunology, Bioprocess, rDNA technology and their role in various environments and potential applications of organisms and their molecules.
3. For instance, if you major in Biotechnology, you can also still take courses from across the other complementary.
4. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as pharmaceutical sector, medical laboratories, agriculture, environmental management, animal veterinary as well as teaching and research.
5. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
6. Understand the applications of techniques to various fields of biology.
7. When you graduate with a Master of Science (Biotechnology) you will have learnt how to work at a high level of academic achievement.
8. Work to deadlines under pressure and communicate effectively.

M.Sc. Sem-I Biotechnology Course Structure

Course Code	Course Name	Type	Credit	Hours Per Week	Internal Marks	External Marks	Total Marks
SC2M26DSCCBIO101	Plant Biotechnology	Theory	4	4	50	50	100
SC2M26DSCCBIO102	Principles of Classical genetics	Theory	4	4	50	50	100
SC2M26DSCCBIO103	Microbial Biotechnology	Theory	4	4	50	50	100
SC2M26PDSCCBIO104	Plant Biotechnology Principles of Classical genetics	Practical	4	8	50	50	100
SC2M26MDCBIO105	Fundamentals of immunology	Theory	2	2	25	25	50
SC2M26PMDCBIO106	Fundamentals of immunology	Practical	2	4	25	25	50
SC2M26VACBIO107	Interdisciplinary Applications of Biotechnology	Theory	2	2	25	25	50
	TOTAL		22	28	275	275	550

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY, PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Plant Biotechnology **SC2M26DSCCBIO101**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Theory**	External**50marks** Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the principles of plant biotechnology and its relevance to agriculture and industry, markers.
- Describe the key techniques and tools used in plant biotechnology, such as genetic modification, tissue culture and molecular
- Utilize molecular biology techniques to enhance traits such as resistance to pests, diseases, and environmental stress.
- Discuss the ethical, environmental, and regulatory considerations associated with plant biotechnology. Evaluate the implications of genetically modified organisms (GMOs) in agriculture and food systems.

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Overview and Scope of Plant Biotechnology-Historical Development and Importance, Applications in Agriculture, Horticulture, and Forestry, plant tissue culture lab, equipment, chemicals, plant tissue culture media and formulation	1	15
2	UNIT-2	Principles of Plant Tissue Culture, totipotency, explants Types of Cultures: Callus, Suspension, Protoplast, Embryo, and Organ Culture, Somatic Embryogenesis and Organogenesis	1	15
3	UNIT-3	Gene Cloning and Vectors- Cloning Vectors: Ti Plasmid, Ri Plasmid, Binary and Cointegrate Vectors, Agrobacterium-Mediated Gene Transfer, Direct Gene Transfer Methods: chemical and physical methods-Microinjection, Biolistics, Electroporation	1	15
4	UNIT-4	Development and Applications of GM Crops (Herbicide Resistance, Pest Resistance, Disease Resistance, insect resistance-bt cotton), Conservation of Plant Genetic Resources (Cryopreservation), artificial seeds,	1	15

References:

1. Introduction to Plant Biotechnology by H.S.Chawla
2. Miglani. Dictionary of plant genetics and molecular biology. Viva Books.
3. Iganacimatha. Appl. Plant Biotechnology.
4. K.K. De. Plant tissue culture.
5. Razdan and Bhojwani. Plant and tissue culture**.**

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Principles of Classical genetics **SC2M26DSCCBIO102**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04 (04Periods/Week)	**Theory**	External**50marks** Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- **Explain the** basic principles of inheritance **and apply Mendelian laws to solve genetic problems.**
- **Analyze** linkage, recombination, and gene mapping **concepts and interpret chromosomal behavior during meiosis.**
- **Understand** sex determination mechanisms and non-Mendelian inheritance patterns**, including cytoplasmic inheritance.**
- **Describe different types of** mutations and chromosomal aberrations **and assess their biological significance.**
- **Solve** genetic numerical problems and pedigree analyses **using logical and analytical skills.**

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to genetics and inheritance; Mendel's life and experiments on pea plants; Concept of gene, allele, genotype and phenotype, Mendel's laws of inheritance Law of dominance, segregation, and independent assortment	1	15
2	UNIT-2	Extensions of Mendelian genetics – incomplete dominance, codominance, multiple alleles, pleiotropy; Deviations from Mendelian ratios and their genetic basis.	1	15
3	UNIT-3	Concept of linkage and recombination; Types of linkage – complete and incomplete; Crossing over and its cytological basis; Factors affecting crossing over; Chromosomal theory of inheritance; Gene mapping and construction of linkage maps	1	15
4	UNIT-4	Mechanisms of sex determination – chromosomal (XX-XY, XX-XO), genic, environmental sex determination; Sex-influenced inheritance. Definition and types of gene mutation, Physical and chemical mutagens; Chromosomal aberrations, Significance of mutations and chromosomal aberrations in evolution, breeding, and disease.	1	15

Reference Books

1. Gardner, Simmons & Snustad – *Principles of Genetics*
2. Strickberger – *Genetics*
3. Griffiths et al. – *An Introduction to Genetic Analysis*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Microbial Biotechnology **SC2M26DSCCBIO103**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Theory**	External **25 marks** Internal **25 marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the scope and importance of microbial biotechnology and describe microbial growth kinetics.
- Identify industrially important microorganisms used in food, pharmaceutical and enzyme industries.
- Understand principles of fermentation technology, including fermenter design and downstream processing.
- Describe diverse applications of microbial biotechnology in agriculture, medicine, environment and waste management.

No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to microbial biotechnology; Historical development and scope; Role of microorganisms in biotechnology; Microbial growth kinetics Microorganisms used in industrial processes; Microbes in food industry – lactic acid bacteria, yeast, molds; Microbes in pharmaceutical industry	1	15
2	UNIT-2	Principles of fermentation; Types of fermentation – solid-state and submerged fermentation; Fermenters and bioreactors – design, components and operation; Applications in agriculture – biofertilizers, biopesticides; Applications in medicine – antibiotics, probiotics, vaccines; Environmental applications	1	15

Reference Books

1. Stanbury, Whitaker & Hall – *Principles of Fermentation Technology*
2. Prescott, Harley & Klein – *Microbiology*
3. Casida – *Industrial Microbiology*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Plant Biotechnology (Group B) Practicals **SC2M26PDSCCBIO104**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Practical**	External**25 marks**
		Internal**25 marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the principles of plant biotechnology and its relevance to agriculture and industry, markers.
- Describe the key techniques and tools used in plant biotechnology, such as genetic modification, tissue culture and molecular
- Utilize molecular biology techniques to enhance traits such as resistance to pests, diseases, and environmental stress.
- Discuss the ethical, environmental, and regulatory considerations associated with plant biotechnology. Evaluate the implications of genetically modified organisms (GMOs) in agriculture and food systems.

Sr. No.		**Credit**	**Hrs.**
Group A	1. Preparation and sterilization of media, glassware, and plant materials. 2. Use of autoclave, laminar airflow and surface sterilization methods. 3. Preparation of Murashige and Skoog (MS) medium. 4. Callus induction and maintenance from explants (leaf, stem, root). 5. Micropropagation using shoot tip and nodal segments. 6. Subculture of callus 7. Cell suspension culture 8. Anther culture		
Group B	1. Numerical problems based on Mendelian crosses 2. Linkage and recombination calculations 3. Gene mapping exercises 4. Pedigree analysis of inherited traits 5. Identification and interpretation of mutant phenotypes		
Group C	1. Study of microbial growth curve 2. Isolation and screening of industrial microorganisms 3. Fermentation process demonstration 4. Enzyme production by microorganisms 5. Case studies of industrial fermentation processes		

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Fundamentals of immunology **SC2M26MDCBIO105**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Theory**	External**25marks**
		Internal**25marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the structure, function, and organization of the immune system.
- Differentiate between innate and adaptive immunity and describe their components.
- Describe antigen-antibody interactions and the role of immunoglobulins
- Understand immune response mechanisms and basic immunological disorders such as hypersensitivity and autoimmunity.

No.			**Credit**	**Hrs.**
1	UNIT-1	History and scope of Immunology Types of immunity: Innate and Adaptive immunity Cells and organs of the immune system Primary lymphoid organs (Bone marrow, Thymus) Secondary lymphoid organs (Spleen, Lymph nodes) Components of innate immunity Physical and chemical barriers Cellular components (Macrophages, Neutrophils, NK cells)	1	15
2	UNIT-2	Antigens and their properties Structure and classes of antibodies (Immunoglobulins: IgG, IgA, IgM, IgE, IgD) Cells of adaptive immunity (B cells and T cells) Humoral vs Cell-mediated immunity Antigen-antibody interactions	1	15

Reference Books

1. Basic Immunology – *Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai*
2. Cellular and Molecular Immunology – *Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai*
3. Textbook of Immunology – *Seemi Farhat Basir*
4. Kuby Immunology – *Thomas J. Kindt, Richard A. Goldsby & Barbara A. Osborne*
5. Janeway's Immunobiology – *Kenneth Murphy & Casey Weaver*
6. Immunology: An Introductory Textbook – *Anil K. Sharma*
7. Textbook of Microbiology and Immunology – *Sudha R. Parija*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Fundamentals of immunology **SC2M26PMDCBIO106**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Practical**	External**25marks**
		Internal**25marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the structure, function, and organization of the immune system.
- Differentiate between innate and adaptive immunity and describe their components.
- Describe antigen-antibody interactions and the role of immunoglobulins
- Understand immune response mechanisms and basic immunological disorders such as hypersensitivity and autoimmunity.

No.		Credit	Hrs.
	1. Study of laboratory safety and handling of biological samples 2. Identification of immune cells (lymphocytes, neutrophils, monocytes) using stained blood smear 3. Determination of blood groups (ABO and Rh typing) 4. Radial immunodiffusion (Mancini method) for antigen estimation 5. ELISA (Enzyme-Linked Immunosorbent Assay) – demonstration/virtual lab 6. Widal test for detection of typhoid (agglutination method) 7. Immunoelectrophoresis (demonstration)		

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Interdisciplinary Applications of Biotechnology **SC2M26VACBIO107**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Theory**	External**50marks**
		Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Understand the concept and importance of interdisciplinary approaches in biotechnology.
- Explain the integration of biotechnology with medicine, engineering, agriculture, and environmental sciences.
- Analyze real-world problems and propose biotechnological solutions using multidisciplinary knowledge.
- Apply bioinformatics, AI, and computational tools in biological research and innovation.
- Recognize ethical, social, and regulatory aspects of biotechnology applications.

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to interdisciplinary science and its relevance in biotechnology, Integration of biotechnology with physics, chemistry, engineering, medicine, and environmental sciences, Role of biotechnology in innovation, entrepreneurship, and sustainable development	1	15
2	UNIT-2	Introduction to nanobiotechnology: concepts and scope Types of nanomaterials used in biotechnology,Green synthesis of nanoparticles using biological systems, Applications of nanobiotechnology in diagnostics, imaging, and targeted drug delivery	1	15
3	UNIT-3	Introduction to neuroscience and its interdisciplinary nature Structure and function of the nervous system: central and peripheral nervous systems, Neurons structure, types, and biological significance, Role of biotechnology in neuroscience research, Applications of neuroscience in biotechnology. Ethical issues and future prospects.	1	15
4	UNIT-4	Concept and scope of digital biotechnology, Integration of biotechnology with digital technologies: information technology, data science, artificial intelligence, and Internet of Things (IoT), Overview of smart healthcare systems and digital health ecosystem Role of digital tools in biological data generation and analysis, Applications of digital biotechnology in disease diagnosis, treatment planning, and preventive healthcare	1	15

Reference Books

1. **Ratledge, C. & Kristiansen, B.** – *Basic Biotechnology*, Cambridge University Press.
2. **Glick, B.R., Pasternak, J.J. & Patten, C.L.** – *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, ASM Press.
3. **Nigam, P.S. & Pandey, A.** – *Biotechnology for Agro-Industrial Residues Utilisation*, Springer.
4. **Sahoo, S.K. & Labhasetwar, V.** – *Nanotechnology in Drug Delivery*, Springer.
5. **Kandel, E.R., Schwartz, J.H., Jessell, T.M.** – *Principles of Neural Science*, McGraw-Hill.
6. **Illes, J.** – *Neuroethics: Defining the Issues in Theory, Practice, and Policy*, Oxford University Press.
7. **Wickramasinghe, N. & Schaffer, J.L.** – *Digital Healthcare*, Springer.
8. **Reddy, K.V. & Gupta, A.** – *Healthcare Data Analytics*, Wiley India.

Supplementary / NEP-Friendly Books

1. **Pandey, A.** – *Industrial Biotechnology*, Elsevier.
2. **Lakhtakia, R.** – *Nanobiotechnology*, I.K. International.
3. **Bose, B. & Roy, S.** – *Emerging Trends in Biotechnology*, Academic Press.

E-Resources

- NCBI (National Center for Biotechnology Information)
- WHO Digital Health Resources
- NIH – Brain & Neuroscience Research Portal
- Nature Biotechnology & Trends in Biotechnology (Review Articles)
- Coursera / SWAYAM MOOCs on Nanotechnology & Digital Health

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN

M.Sc. Biotechnology Syllabus (New Education Policy-NEP)

Document code	**Syllabus Biotechnology NEP-2023**
Name of faculty	**Science**
Faculty code	**SCI**
Programme name	**Postgraduate(M.Sc.)**
Subject	**Biotechnology**
Programme code	**SCIPG106**
Effective from	**June-2026**

Hemchandracharya North Gujarat University, Patan

M. Sc. Biotechnology Syllabus

(TWO YEAR)

(COURSE WORK WITH RESEARCH PROGRAM)

w.e.f.

from 2026-27 under NEP-2023

The proposed new structure for M. Sc. Course (2 years with Research) is based on NEP-2020 which is in force June- 2026.

Course Pattern

3. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
4. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

PROGRAMMEOBJECTIVE

9. The primary objective of the program is to impart quality education in the subject of Biotechnology as a basic science and its applied branches to the students. The Department has the following objectives:
10. To provide quality education in a branch of biological sciences i.e. Biotechnology with different specializations.
11. To facilitate higher education & research in Biotechnology.
12. To provide quality education, offering skill-based programs and motivate the students for self-employment in applied branches of Biotechnology.
13. To Inculcate the spirit of resource conservation and love for nature.
14. To conduct field studies/Industrial visits and different projects of local and global interests.
15. To provide opportunities for professional and personal development through curricular and co-curricular activities.
16. Provide consultancy and organize extension activities.

PROGRAMMEOUTCOMES

9. The programme also works across related majors within the M.Sc. Biotechnology.
10. To understand complex microbial physiology, immunology, Bioprocess, Microbes and their role in various environments and potential applications of microbes.
11. For instance, if you major in Biotechnology, you can also still take courses from across the other complementary.
12. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as pharmaceutical sector, medical laboratories, agriculture, environmental management, biotechnology as well as teaching and research.
13. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
14. Understand the applications of microbial techniques to various fields of biology.
15. When you graduate with a Master of Science (Biotechnology) you will have learned how to work at a high level of academic achievement.
16. Work to deadlines under pressure and communicate effectively.

M.Sc. Sem-I Biotechnology Course Structure

Course Code	Course Name	Type	Credit	Hours Per Week	Internal Marks	External Marks	Total Marks
SC2M26DSCCBIO101	Plant Biotechnology	Theory	4	4	50	50	100
SC2M26DSCCBIO102	Principles of Classical genetics	Theory	4	4	50	50	100
SC2M26DSCCBIO103	Microbial Biotechnology	Theory	4	4	50	50	100
SC2M26PDSCCBIO104	Plant Biotechnology Principles of Classical genetics	Practical	4	8	50	50	100
SC2M26MDCBT105	Fundamentals of immunology	Theory	2	2	25	25	50
SC2M26PMDCBT106	Fundamentals of immunology	Practical	2	4	25	25	50
SC2M26VACBT107	Interdisciplinary Applications of Biotechnology	Theory	2	2	25	25	50
	TOTAL		22	28	275	275	550

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY, PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Plant Biotechnology **SC2M26DSCCBIO101**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Theory**	External**50marks**
		Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the principles of plant biotechnology and its relevance to agriculture and industry, markers.
- Describe the key techniques and tools used in plant biotechnology, such as genetic modification, tissue culture and molecular
- Utilize molecular biology techniques to enhance traits such as resistance to pests, diseases, and environmental stress.
- Discuss the ethical, environmental, and regulatory considerations associated with plant biotechnology. Evaluate the implications of genetically modified organisms (GMOs) in agriculture and food systems.

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Overview and Scope of Plant Biotechnology-Historical Development and Importance, Applications in Agriculture, Horticulture, and Forestry, plant tissue culture lab, equipment, chemicals, plant tissue culture media and formulation	1	15
2	UNIT-2	Principles of Plant Tissue Culture, totipotency, explants Types of Cultures: Callus, Suspension, Protoplast, Embryo, and Organ Culture, Somatic Embryogenesis and Organogenesis	1	15
3	UNIT-3	Gene Cloning and Vectors- Cloning Vectors: Ti Plasmid, Ri Plasmid, Binary and Cointegrate Vectors, Agrobacterium-Mediated Gene Transfer, Direct Gene Transfer Methods: chemical and physical methods-Microinjection, Biolistics, Electroporation	1	15
4	UNIT-4	Development and Applications of GM Crops (Herbicide Resistance, Pest Resistance, Disease Resistance, insect resistance-bt cotton), Conservation of Plant Genetic Resources (Cryopreservation), artificial seeds,	1	15

References:

6. Introduction to Plant Biotechnology by H.S.Chawla
7. Miglani. Dictionary of plant genetics and molecular biology. Viva Books.
8. Iganacimatha. Appl. Plant Biotechnology.
9. K.K. De. Plant tissue culture.
10. Razdan and Bhojwani. Plant and tissue culture.

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Principles of Classical genetics **SC2M26DSCCBIO102**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04 (04Periods/Week)	**Theory**	External**50marks**
		Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- **Explain the** basic principles of inheritance **and apply Mendelian laws to solve genetic problems.**
- **Analyze** linkage, recombination, and gene mapping **concepts and interpret chromosomal behavior during meiosis.**
- **Understand** sex determination mechanisms and non-Mendelian inheritance patterns**, including cytoplasmic inheritance.**
- **Describe different types of** mutations and chromosomal aberrations **and assess their biological significance.**
- **Solve** genetic numerical problems and pedigree analyses **using logical and analytical skills.**

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to genetics and inheritance; Mendel's life and experiments on pea plants; Concept of gene, allele, genotype and phenotype, Mendel's laws of inheritance Law of dominance, segregation, and independent assortment	1	15
2	UNIT-2	Extensions of Mendelian genetics – incomplete dominance, codominance, multiple alleles, pleiotropy; Deviations from Mendelian ratios and their genetic basis.	1	15
3	UNIT-3	Concept of linkage and recombination; Types of linkage – complete and incomplete; Crossing over and its cytological basis; Factors affecting crossing over; Chromosomal theory of inheritance; Gene mapping and construction of linkage maps	1	15
4	UNIT-4	Mechanisms of sex determination – chromosomal (XX-XY, XX-XO), genic, environmental sex determination; Sex-influenced inheritance. Definition and types of gene mutation, Physical and chemical mutagens; Chromosomal aberrations, Significance of mutations and chromosomal aberrations in evolution, breeding, and disease.	1	15

Reference Books

4. Gardner, Simmons & Snustad – *Principles of Genetics*
5. Strickberger – *Genetics*
6. Griffiths et al. – *An Introduction to Genetic Analysis*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Microbial Biotechnology **SC2M26DSCCBIO103**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Theory**	External **25 marks** Internal **25 marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the scope and importance of microbial biotechnology and describe microbial growth kinetics.
- Identify industrially important microorganisms used in food, pharmaceutical and enzyme industries.
- Understand principles of fermentation technology, including fermenter design and downstream processing.
- Describe diverse applications of microbial biotechnology in agriculture, medicine, environment and waste management.

No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to microbial biotechnology; Historical development and scope; Role of microorganisms in biotechnology; Microbial growth kinetics Microorganisms used in industrial processes; Microbes in food industry – lactic acid bacteria, yeast, molds; Microbes in pharmaceutical industry	1	15
2	UNIT-2	Principles of fermentation; Types of fermentation – solid-state and submerged fermentation; Fermenters and bioreactors – design, components and operation; Applications in agriculture – biofertilizers, biopesticides; Applications in medicine – antibiotics, probiotics, vaccines; Environmental applications	1	15

Reference Books

4. Stanbury, Whitaker & Hall – *Principles of Fermentation Technology*
5. Prescott, Harley & Klein – *Microbiology*
6. Casida – *Industrial Microbiology*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Plant Biotechnology (Group B) Practicals **SC2M26PDSCCBIO104**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Practical**	External**25 marks**
		Internal**25 marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the principles of plant biotechnology and its relevance to agriculture and industry, markers.
- Describe the key techniques and tools used in plant biotechnology, such as genetic modification, tissue culture and molecular
- Utilize molecular biology techniques to enhance traits such as resistance to pests, diseases, and environmental stress.
- Discuss the ethical, environmental, and regulatory considerations associated with plant biotechnology. Evaluate the implications of genetically modified organisms (GMOs) in agriculture and food systems.

Sr. No.		**Credit**	**Hrs.**
Group A	9. Preparation and sterilization of media, glassware, and plant materials. 10. Use of autoclave, laminar airflow and surface sterilization methods. 11. Preparation of Murashige and Skoog (MS) medium. 12. Callus induction and maintenance from explants (leaf, stem, root). 13. Micropropagation using shoot tip and nodal segments. 14. Subculture of callus 15. Cell suspension culture 16. Anther culture		
Group B	6. Numerical problems based on Mendelian crosses 7. Linkage and recombination calculations 8. Gene mapping exercises 9. Pedigree analysis of inherited traits 10. Identification and interpretation of mutant phenotypes		
Group C	6. Study of microbial growth curve 7. Isolation and screening of industrial microorganisms 8. Fermentation process demonstration 9. Enzyme production by microorganisms 10. Case studies of industrial fermentation processes		

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Fundamentals of immunology **SC2M26MDCBT105**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Theory**	External**25marks**
		Internal**25marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the structure, function, and organization of the immune system.
- Differentiate between innate and adaptive immunity and describe their components.
- Describe antigen-antibody interactions and the role of immunoglobulins
- Understand immune response mechanisms and basic immunological disorders such as hypersensitivity and autoimmunity.

No.			**Credit**	**Hrs.**
1	UNIT-1	History and scope of Immunology Types of immunity: Innate and Adaptive immunity Cells and organs of the immune system Primary lymphoid organs (Bone marrow, Thymus) Secondary lymphoid organs (Spleen, Lymph nodes) Components of innate immunity Physical and chemical barriers Cellular components (Macrophages, Neutrophils, NK cells)	1	15
2	UNIT-2	Antigens and their properties Structure and classes of antibodies (Immunoglobulins: IgG, IgA, IgM, IgE, IgD) Cells of adaptive immunity (B cells and T cells) Humoral vs Cell-mediated immunity Antigen-antibody interactions	1	15

Reference Books

8. Basic Immunology – *Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai*
9. Cellular and Molecular Immunology – *Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai*
10. Textbook of Immunology – *Seemi Farhat Basir*
11. Kuby Immunology – *Thomas J. Kindt, Richard A. Goldsby & Barbara A. Osborne*
12. Janeway's Immunobiology – *Kenneth Murphy & Casey Weaver*
13. Immunology: An Introductory Textbook – *Anil K. Sharma*
14. Textbook of Microbiology and Immunology – *Sudha R. Parija*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Fundamentals of immunology **SC2M26PMDCBT106**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Practical**	External**25marks** Internal**25marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the structure, function, and organization of the immune system.
- Differentiate between innate and adaptive immunity and describe their components.
- Describe antigen-antibody interactions and the role of immunoglobulins
- Understand immune response mechanisms and basic immunological disorders such as hypersensitivity and autoimmunity.

No.		**Credit**	**Hrs.**
	8. Study of laboratory safety and handling of biological samples 9. Identification of immune cells (lymphocytes, neutrophils, monocytes) using stained blood smear 10. Determination of blood groups (ABO and Rh typing) 11. Radial immunodiffusion (Mancini method) for antigen estimation 12. ELISA (Enzyme-Linked Immunosorbent Assay) – demonstration/virtual lab 13. Widal test for detection of typhoid (agglutination method) 14. Immunoelectrophoresis (demonstration)		

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Interdisciplinary Applications of Biotechnology **SC2M26VACBT107**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Theory**	External**50marks**
		Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Understand the concept and importance of interdisciplinary approaches in biotechnology.
- Explain the integration of biotechnology with medicine, engineering, agriculture, and environmental sciences.
- Analyze real-world problems and propose biotechnological solutions using multidisciplinary knowledge.
- Apply bioinformatics, AI, and computational tools in biological research and innovation.
- Recognize ethical, social, and regulatory aspects of biotechnology applications.

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to interdisciplinary science and its relevance in biotechnology, Integration of biotechnology with physics, chemistry, engineering, medicine, and environmental sciences, Role of biotechnology in innovation, entrepreneurship, and sustainable development	1	15
2	UNIT-2	Introduction to nanobiotechnology: concepts and scope Types of nanomaterials used in biotechnology,Green synthesis of nanoparticles using biological systems, Applications of nanobiotechnology in diagnostics, imaging, and targeted drug delivery	1	15
3	UNIT-3	Introduction to neuroscience and its interdisciplinary nature Structure and function of the nervous system: central and peripheral nervous systems, Neurons structure, types, and biological significance, Role of biotechnology in neuroscience research, Applications of neuroscience in biotechnology. Ethical issues and future prospects.	1	15
4	UNIT-4	Concept and scope of digital biotechnology, Integration of biotechnology with digital technologies: information technology, data science, artificial intelligence, and Internet of Things (IoT), Overview of smart healthcare systems and digital health ecosystem Role of digital tools in biological data generation and analysis, Applications of digital biotechnology in disease diagnosis, treatment planning, and preventive healthcare	1	15

Reference Books

9. **Ratledge, C. & Kristiansen, B.** – *Basic Biotechnology*, Cambridge University Press.
10. **Glick, B.R., Pasternak, J.J. & Patten, C.L.** – *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, ASM Press.
11. **Nigam, P.S. & Pandey, A.** – *Biotechnology for Agro-Industrial Residues Utilisation*, Springer.
12. **Sahoo, S.K. & Labhasetwar, V.** – *Nanotechnology in Drug Delivery*, Springer.
13. **Kandel, E.R., Schwartz, J.H., Jessell, T.M.** – *Principles of Neural Science*, McGraw-Hill.
14. **Illes, J.** – *Neuroethics: Defining the Issues in Theory, Practice, and Policy*, Oxford University Press.
15. **Wickramasinghe, N. & Schaffer, J.L.** – *Digital Healthcare*, Springer.
16. **Reddy, K.V. & Gupta, A.** – *Healthcare Data Analytics*, Wiley India.

Supplementary / NEP-Friendly Books

4. **Pandey, A.** – *Industrial Biotechnology*, Elsevier.
5. **Lakhtakia, R.** – *Nanobiotechnology*, I.K. International.
6. **Bose, B. & Roy, S.** – *Emerging Trends in Biotechnology*, Academic Press.

E-Resources

- NCBI (National Center for Biotechnology Information)
- WHO Digital Health Resources
- NIH – Brain & Neuroscience Research Portal
- Nature Biotechnology & Trends in Biotechnology (Review Articles)
- Coursera / SWAYAM MOOCs on Nanotechnology & Digital Health

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN

M.Sc. Biotechnology Syllabus (New Education Policy-NEP)

Document code	**Syllabus Biotechnology NEP-2023**
Name of faculty	**Science**
Faculty code	**SCI**
Programme name	**Postgraduate(M.Sc.)**
Subject	**Biotechnology**
Programme code	**SCIPG106**
Effective from	**June-2026**

Hemchandracharya North Gujarat University, Patan

M. Sc. Biotechnology Syllabus

(TWO YEAR)
(RESEARCH ONLY PROGRAMME)

w.e.f.

from June 2026 under NEP 2023

The proposed new structure for M. Sc. Course (2 years with course work and research) is based on NEP-2020 which is in force June- 2026.

Course Pattern

5. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
6. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

3. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

4. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMMEOBJECTIVE

17. The primary objective of the program is to impart quality education in the subject of Biotechnology as an applied science and its applied branches to the students. The Department has the following objectives:
18. To provide quality education in a branch of biological sciences i.e. Biotechnology with different specializations.
19. To facilitate higher education & research in Biotechnology.
20. To provide quality education, offering skill-based programs and motivate the students for self-employment in applied branches of Biotechnology.
21. To inculcate the spirit of resource conservation and love for nature.
22. To conduct field studies/Industrial visits and different projects of local and global interests.
23. To provide opportunities for professional and personal development through curricular and co-curricular activities.
24. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

17. The programme also works across related majors within the M.Sc. Biotechnology.
18. To understand complex Plant Biotechnology, Animal Biotechnology, immunology, Bioprocess, rDNA technology and their role in various environments and potential applications of organisms and their molecules.
19. For instance, if you major in Biotechnology, you can also still take courses from across the other complementary.
20. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as pharmaceutical sector, medical laboratories, agriculture, environmental management, animal veterinary as well as teaching and research.
21. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
22. Understand the applications of techniques to various fields of biology.
23. When you graduate with a Master of Science (Biotechnology) you will have learnt how to work at a high level of academic achievement.
24. Work to deadlines under pressure and communicate effectively.
25.

M.Sc. Sem-I Biotechnology Course Structure

Course Code	Course Name	Type	Credit	Hours Per Week	Internal Marks	External Marks	Total Marks
SC2M26DSCCBIO101	Plant Biotechnology	Theory	4	4	50	50	100
SC2M26DSCCBIO102	Principles of Classical genetics	Theory	4	4	50	50	100
SC2M26DSCCBIO103	Microbial Biotechnology	Theory	4	4	50	50	100
SC2M26PDSCCBIO104	Plant Biotechnology Principles of Classical genetics	Practical	4	8	50	50	100
SC2M26MDCBIO105	Fundamentals of immunology	Theory	2	2	25	25	50
SC2M26PMDCBIO106	Fundamentals of immunology	Practical	2	4	25	25	50
SC2M26VACBIO107	Interdisciplinary Applications of Biotechnology	Theory	2	2	25	25	50
	TOTAL		22	28	275	275	550

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY, PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Plant Biotechnology **SC2M26DSCCBIO101**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Theory**	External**50marks** Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the principles of plant biotechnology and its relevance to agriculture and industry, markers.
- Describe the key techniques and tools used in plant biotechnology, such as genetic modification, tissue culture and molecular
- Utilize molecular biology techniques to enhance traits such as resistance to pests, diseases, and environmental stress.
- Discuss the ethical, environmental, and regulatory considerations associated with plant biotechnology. Evaluate the implications of genetically modified organisms (GMOs) in agriculture and food systems.

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Overview and Scope of Plant Biotechnology-Historical Development and Importance, Applications in Agriculture, Horticulture, and Forestry, plant tissue culture lab, equipment, chemicals, plant tissue culture media and formulation	1	15
2	UNIT-2	Principles of Plant Tissue Culture, totipotency, explants Types of Cultures: Callus, Suspension, Protoplast, Embryo, and Organ Culture, Somatic Embryogenesis and Organogenesis	1	15
3	UNIT-3	Gene Cloning and Vectors- Cloning Vectors: Ti Plasmid, Ri Plasmid, Binary and Cointegrate Vectors, Agrobacterium-Mediated Gene Transfer, Direct Gene Transfer Methods: chemical and physical methods-Microinjection, Biolistics, Electroporation	1	15
4	UNIT-4	Development and Applications of GM Crops (Herbicide Resistance, Pest Resistance, Disease Resistance, insect resistance-bt cotton), Conservation of Plant Genetic Resources (Cryopreservation), artificial seeds,	1	15

References:

11. Introduction to Plant Biotechnology by H.S.Chawla
12. Miglani. Dictionary of plant genetics and molecular biology. Viva Books.
13. Iganacimatha. Appl. Plant Biotechnology.
14. K.K. De. Plant tissue culture.
15. Razdan and Bhojwani. Plant and tissue culture.

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Principles of Classical genetics **SC2M26DSCCBIO102**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04 (04Periods/Week)	**Theory**	External**50marks**
		Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- **Explain the** basic principles of inheritance **and apply Mendelian laws to solve genetic problems.**
- **Analyze** linkage, recombination, and gene mapping **concepts and interpret chromosomal behavior during meiosis.**
- **Understand** sex determination mechanisms and non-Mendelian inheritance patterns**, including cytoplasmic inheritance.**
- **Describe different types of** mutations and chromosomal aberrations **and assess their biological significance.**
- **Solve** genetic numerical problems and pedigree analyses **using logical and analytical skills.**

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to genetics and inheritance; Mendel's life and experiments on pea plants; Concept of gene, allele, genotype and phenotype, Mendel's laws of inheritance Law of dominance, segregation, and independent assortment	1	15
2	UNIT-2	Extensions of Mendelian genetics – incomplete dominance, codominance, multiple alleles, pleiotropy; Deviations from Mendelian ratios and their genetic basis.	1	15
3	UNIT-3	Concept of linkage and recombination; Types of linkage – complete and incomplete; Crossing over and its cytological basis; Factors affecting crossing over; Chromosomal theory of inheritance; Gene mapping and construction of linkage maps	1	15
4	UNIT-4	Mechanisms of sex determination – chromosomal (XX-XY, XX-XO), genic, environmental sex determination; Sex-influenced inheritance. Definition and types of gene mutation, Physical and chemical mutagens; Chromosomal aberrations, Significance of mutations and chromosomal aberrations in evolution, breeding, and disease.	1	15

Reference Books

7. Gardner, Simmons & Snustad – *Principles of Genetics*
8. Strickberger – *Genetics*
9. Griffiths et al. – *An Introduction to Genetic Analysis*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Microbial Biotechnology **SC2M26DSCCBIO103**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Theory**	External **25 marks** Internal **25 marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the scope and importance of microbial biotechnology and describe microbial growth kinetics.
- Identify industrially important microorganisms used in food, pharmaceutical and enzyme industries.
- Understand principles of fermentation technology, including fermenter design and downstream processing.
- Describe diverse applications of microbial biotechnology in agriculture, medicine, environment and waste management.

No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to microbial biotechnology; Historical development and scope; Role of microorganisms in biotechnology; Microbial growth kinetics Microorganisms used in industrial processes; Microbes in food industry – lactic acid bacteria, yeast, molds; Microbes in pharmaceutical industry	1	15
2	UNIT-2	Principles of fermentation; Types of fermentation – solid-state and submerged fermentation; Fermenters and bioreactors – design, components and operation; Applications in agriculture – biofertilizers, biopesticides; Applications in medicine – antibiotics, probiotics, vaccines; Environmental applications	1	15

Reference Books

7. Stanbury, Whitaker & Hall – *Principles of Fermentation Technology*
8. Prescott, Harley & Klein – *Microbiology*
9. Casida – *Industrial Microbiology*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Plant Biotechnology (Group B) Practicals **SC2M26PDSCCBIO104**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Practical**	External**25 marks** Internal**25 marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the principles of plant biotechnology and its relevance to agriculture and industry, markers.
- Describe the key techniques and tools used in plant biotechnology, such as genetic modification, tissue culture and molecular
- Utilize molecular biology techniques to enhance traits such as resistance to pests, diseases, and environmental stress.
- Discuss the ethical, environmental, and regulatory considerations associated with plant biotechnology. Evaluate the implications of genetically modified organisms (GMOs) in agriculture and food systems.

Sr. No.		Credit	Hrs.
Group A	17. Preparation and sterilization of media, glassware, and plant materials. 18. Use of autoclave, laminar airflow and surface sterilization methods. 19. Preparation of Murashige and Skoog (MS) medium. 20. Callus induction and maintenance from explants (leaf, stem, root). 21. Micropropagation using shoot tip and nodal segments. 22. Subculture of callus 23. Cell suspension culture 24. Anther culture		
Group B	11. Numerical problems based on Mendelian crosses 12. Linkage and recombination calculations 13. Gene mapping exercises 14. Pedigree analysis of inherited traits 15. Identification and interpretation of mutant phenotypes		
Group C	11. Study of microbial growth curve 12. Isolation and screening of industrial microorganisms 13. Fermentation process demonstration 14. Enzyme production by microorganisms 15. Case studies of industrial fermentation processes		

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Fundamentals of immunology **SC2M26MDCBIO105**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Theory**	External**25marks**
		Internal**25marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the structure, function, and organization of the immune system.
- Differentiate between innate and adaptive immunity and describe their components.
- Describe antigen-antibody interactions and the role of immunoglobulins
- Understand immune response mechanisms and basic immunological disorders such as hypersensitivity and autoimmunity.

No.			**Credit**	**Hrs.**
1	UNIT-1	History and scope of Immunology Types of immunity: Innate and Adaptive immunity Cells and organs of the immune system Primary lymphoid organs (Bone marrow, Thymus) Secondary lymphoid organs (Spleen, Lymph nodes) Components of innate immunity Physical and chemical barriers Cellular components (Macrophages, Neutrophils, NK cells)	1	15
2	UNIT-2	Antigens and their properties Structure and classes of antibodies (Immunoglobulins: IgG, IgA, IgM, IgE, IgD) Cells of adaptive immunity (B cells and T cells) Humoral vs Cell-mediated immunity Antigen-antibody interactions	1	15

Reference Books

15. Basic Immunology – *Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai*
16. Cellular and Molecular Immunology – *Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai*
17. Textbook of Immunology – *Seemi Farhat Basir*
18. Kuby Immunology – *Thomas J. Kindt, Richard A. Goldsby & Barbara A. Osborne*
19. Janeway's Immunobiology – *Kenneth Murphy & Casey Weaver*
20. Immunology: An Introductory Textbook – *Anil K. Sharma*
21. Textbook of Microbiology and Immunology – *Sudha R. Parija*

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT(Biotechnology)**

SEMESTER-I

Fundamentals of immunology **SC2M26PMDCBIO106**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-02(02Periods/Week)	**Practical**	External**25marks**
		Internal**25marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Explain the structure, function, and organization of the immune system.
- Differentiate between innate and adaptive immunity and describe their components.
- Describe antigen-antibody interactions and the role of immunoglobulins
- Understand immune response mechanisms and basic immunological disorders such as hypersensitivity and autoimmunity.

No.		Credit	Hrs.
	15. Study of laboratory safety and handling of biological samples 16. Identification of immune cells (lymphocytes, neutrophils, monocytes) using stained blood smear 17. Determination of blood groups (ABO and Rh typing) 18. Radial immunodiffusion (Mancini method) for antigen estimation 19. ELISA (Enzyme-Linked Immunosorbent Assay) – demonstration/virtual lab 20. Widal test for detection of typhoid (agglutination method) 21. Immunoelectrophoresis (demonstration)		

HEMCHANDRACHARYANORTHGUJARATUNIVERSITY,PATAN

SCIPG106 **BT (Biotechnology)**

SEMESTER -I

Interdisciplinary Applications of Biotechnology **SC2M26VACBIO107**

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

TotalCredits-04(04Periods/Week)	**Theory**	External**50marks**
		Internal**50marks**

Program Outcome

- Directly supports NHEQF descriptors for Master's level — deep specialized knowledge in the discipline, building on undergraduate foundations, and integration with emerging areas (e.g., genomics, bioinformatics, bioprocesses). Promotes multidisciplinary education.
- Emphasizes analytical skills, hypothesis formulation, data interpretation, and solving complex real-world problems (health, agriculture, environment).
- Focuses on hands-on proficiency, modern tools/techniques, biosafety, and experiential learning (labs, internships, projects).
- Strong emphasis on research, innovation, and contribution to knowledge creation. Supports research projects, dissertations, and industry collaboration.
- Effective oral/written communication of scientific ideas to diverse audiences.
- Covers bioethics, IPR, biosafety, regulatory frameworks, sustainability, and responsible innovation.
- Prepares for employability, entrepreneurship, industry roles, academia, or higher studies (Ph.D.). Includes teamwork and lifelong learning.
- Promotes integration with other fields (e.g., computational biology, nanotechnology) and continuous professional development.

Course Outcome

- Understand the concept and importance of interdisciplinary approaches in biotechnology.
- Explain the integration of biotechnology with medicine, engineering, agriculture, and environmental sciences.
- Analyze real-world problems and propose biotechnological solutions using multidisciplinary knowledge.
- Apply bioinformatics, AI, and computational tools in biological research and innovation.
- Recognize ethical, social, and regulatory aspects of biotechnology applications.

Sr. No.			**Credit**	**Hrs.**
1	UNIT-1	Introduction to interdisciplinary science and its relevance in biotechnology, Integration of biotechnology with physics, chemistry, engineering, medicine, and environmental sciences, Role of biotechnology in innovation, entrepreneurship, and sustainable development	1	15
2	UNIT-2	Introduction to nanobiotechnology: concepts and scope Types of nanomaterials used in biotechnology,Green synthesis of nanoparticles using biological systems, Applications of nanobiotechnology in diagnostics, imaging, and targeted drug delivery	1	15
3	UNIT-3	Introduction to neuroscience and its interdisciplinary nature Structure and function of the nervous system: central and peripheral nervous systems, Neurons structure, types, and biological significance, Role of biotechnology in neuroscience research, Applications of neuroscience in biotechnology. Ethical issues and future prospects.	1	15
4	UNIT-4	Concept and scope of digital biotechnology, Integration of biotechnology with digital technologies: information technology, data science, artificial intelligence, and Internet of Things (IoT), Overview of smart healthcare systems and digital health ecosystem Role of digital tools in biological data generation and analysis, Applications of digital biotechnology in disease diagnosis, treatment planning, and preventive healthcare	1	15

Reference Books

17. **Ratledge, C. & Kristiansen, B.** – *Basic Biotechnology*, Cambridge University Press.
18. **Glick, B.R., Pasternak, J.J. & Patten, C.L.** – *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, ASM Press.
19. **Nigam, P.S. & Pandey, A.** – *Biotechnology for Agro-Industrial Residues Utilisation*, Springer.
20. **Sahoo, S.K. & Labhasetwar, V.** – *Nanotechnology in Drug Delivery*, Springer.
21. **Kandel, E.R., Schwartz, J.H., Jessell, T.M.** – *Principles of Neural Science*, McGraw-Hill.
22. **Illes, J.** – *Neuroethics: Defining the Issues in Theory, Practice, and Policy*, Oxford University Press.
23. **Wickramasinghe, N. & Schaffer, J.L.** – *Digital Healthcare*, Springer.
24. **Reddy, K.V. & Gupta, A.** – *Healthcare Data Analytics*, Wiley India.

Supplementary / NEP-Friendly Books

7. **Pandey, A.** – *Industrial Biotechnology*, Elsevier.
8. **Lakhtakia, R.** – *Nanobiotechnology*, I.K. International.
9. **Bose, B. & Roy, S.** – *Emerging Trends in Biotechnology*, Academic Press.

E-Resources

- NCBI (National Center for Biotechnology Information)
- WHO Digital Health Resources
- NIH – Brain & Neuroscience Research Portal
- Nature Biotechnology & Trends in Biotechnology (Review Articles)
- Coursera / SWAYAM MOOCs on Nanotechnology & Digital Health

HEMCHANDRACHRYA NORTH GUJARAT UNIVERSITY

M.Sc. (Mathematics)

Detailed Syllabus as per NEP-2020 with Effect from: July 2026

FACULTY:	**SCIENCE**
SUBJECT:	**MATHEMATICS**
PROGRAMME NAME:	**MASTER OF SCIENCE**
YEAR:	**TWO YEAR PG Only Course Work**
PROGRAMME CODE:	**SCIPG107**
SEMESTER:	**1 and 2**
DATE:	**10-06-2026**
TOTAL PAGE:	**22 Pages**

MASTERDEGREECOURSE(ONLYCOURSEWORKPROGRAMME)									
Part/Class	Course Type	Subjectcode	Study Components	Hrs/ Week	Examination Marks			Credits	Exam Duration (Hours)
					Internal	External	Total		
M.Sc.Semester-I		SEMESTER-I							
	DSCC1	SC2M26 DSCCMAT101	Ordinary Differential Equations	4	50	50	100	4	02:30
	DSCC2	SC2M26 DSCCMAT102	Mathematics Analysis-II	4	50	50	100	4	
	DSCC3	SC2M26 DSCCMAT103	Complex Analysis	4	50	50	100	4	
	DSCC4	SC2M26PDSCCMAT104	PRACTICAL MATLAB Programing in Numerical Methods	8*	50	50	100	4	06:00*
	MDC1	SC2M26 MDCMAT105	Statistical Methods	2	25	25	50	2	02:00
	MDC2	SC2M26PMDCMAT106	PRACTICAL MATLAB Programing in Ordinary Differential Equations	4*	25	25	50	2	03:00*
	VAC	SC2M26VACMAT107	Integral Transforms	2	25	25	50	2	02:00
		Total		**28**	**275**	**275**	**550**	**22**	
SEMESTERII									
M.Sc.Semester-II	DSCC1	SC2M26DSCCMAT201	Measure Theory	4	50	50	100	4	02:30
	DSCC2	SC2M26DSCCMAT202	Partial Differential Equations	4	50	50	100	4	
	DSCC3	SC2M26DSCCMAT203	Advanced Algebra	4	50	50	100	4	
	DSCC4	SC2M26PDSCCMAT204	PRACTICAL Applications and Problem Solving	8*	50	50	100	4	.06:00*
	MDC	SC2M26 MDCMAT205	Theory of Numbers	2	25	25	50	2	02:00
	SWAY AM	SWAYAM	SWAYAM-Select from Portal	2	25	25	50	2	02:00
	SEC	SC2M26PSECMAT206	PRACTICAL MATLAB Programing in Partial Differential Equations	4*	25	25	50	2	03:00*
	VOC	SC2M26 VOCMAT207	Research Methodology	2	25	25	50	2	02:00
		Total		**28**	**275**	**275**	**550**	**22**	
	NOTE: (1) Student/ Institute choose any one options: either SWAYAM =OR= SEC (2) * Indicates per Batch of 15 Students								

SEMESTER –1

Hemchandracharya North Gujarat University			
Faculty:	**Science**	**Program:**	**(M.Sc.) Two Year Post Graduate Programme**
Subject:	**Mathematics**	**Semester:**	**1**
Program Outcomes:			
1	**Learning Outcomes:** The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:		
2	**Knowledge and understanding:** When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.		
3	**Cognitive skills:** When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.		
4	**Practical skills:** When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.		
The basic requirement for the smooth and better conduction of the practical program:			
1	Must require a Computer operator for better conduction of the practical and maintenance of computer systems.		
2	Must have a computer lab fully equipped with Microsoft Office tools and internet facility.		

<table>
<tr><td>Faculty:</td><td>Science</td><td>Program:</td><td colspan="3">(M.Sc.) Two Year Post Graduate Programme</td></tr>
<tr><td>Subject:</td><td>Mathematics</td><td>Semester:</td><td colspan="3">1</td></tr>
<tr><td>Course Type</td><td>Course Code</td><td colspan="2">Course Name</td><td>Internal / External / Total Marks</td><td>Credits/ Hours</td></tr>
<tr><td>Major-1 Theory</td><td>SC2M26DSCCMAT101</td><td colspan="2">Ordinary Differential Equations</td><td>50 / 50 / 100</td><td>4 / 4</td></tr>
<tr><td colspan="6">Course Outcome</td></tr>
<tr><td>1</td><td colspan="5">Solve linear, exact, and special types of ordinary differential equations using appropriate analytical methods.</td></tr>
<tr><td>2</td><td colspan="5">Apply power series methods, including the Frobenius method, to obtain solutions of ordinary differential equations about ordinary and singular points.</td></tr>
<tr><td>3</td><td colspan="5">Analyze and obtain series solutions of Legendre’s, Bessel’s, Chebyshev, and Gauss hypergeometric differential equations.</td></tr>
<tr><td>4</td><td colspan="5">Examine the properties of special functions associated with differential equations, including generating functions, recurrence relations, Rodrigues’ formula, and orthogonality relations.</td></tr>
<tr><td>Unit</td><td colspan="4">Detail Contents</td><td>Hours</td></tr>
<tr><td>1</td><td colspan="4">Linear differential equations and their general solutions. Exact differential equations and equations of special forms. Linear equations with constant coefficients and with variable coefficients.</td><td>15</td></tr>
<tr><td>2</td><td colspan="4">Homogeneous linear equations. Power series solutions of linear differential equations. Ordinary and singular points of differential equations. Classification of singular points into regular and irregular singular points</td><td>15</td></tr>
<tr><td>3</td><td colspan="4">Series solutions about an ordinary point and a regular singular point. Frobenius method. Power series solutions of Legendre’s equation, Bessel’s equation, Chebyshev equation, and Gauss hypergeometric equation.</td><td>15</td></tr>
<tr><td>4</td><td colspan="4">Generating functions, recurrence relations, Rodrigues’ formula, and orthogonality properties of Legendre, Bessel, Chebyshev, and Gauss hypergeometric functions.</td><td>15</td></tr>
<tr><td colspan="6">Reference Books:</td></tr>
<tr><td>1</td><td colspan="5">Ordinary and Partial Differential Equations by M. D. Raisinghania, S. Chand Publishing, ISBN: 978-81-219-0892-4</td></tr>
<tr><td>2</td><td colspan="5">Differential Equations with Applications and Historical Notes by G. F. Simmons, Tata McGraw-Hill Publishing Company, ISBN: 978-0-07-057540-0.</td></tr>
<tr><td>3</td><td colspan="5">Elementary Differential Equations by E. D. Rainville and P. E. Bedient, Prentice Hall/Pearson Education, ISBN: 978-0-13-508011-5.</td></tr>
<tr><td>4</td><td colspan="5">Theory of Ordinary Differential Equations by E. A. Coddington and N. Levinson, McGraw-Hill Book Company, ISBN: 978-0-07-011008-3.</td></tr>
<tr><td>5</td><td colspan="5">Differential Equations: Linear, Nonlinear, Ordinary, Partial by A. C. King, J. Billingham, and S. R. Otto, Cambridge University Press, ISBN: 978-0-521-73490-5.</td></tr>
</table>

Faculty:	Science	Program:	(M.Sc.) Two Year Post Graduate Programme	
Subject:	**Mathematics**	**Semester:**	**1**	
Course Type	**Course Code**	**Course Name**	**Internal / External / Total Marks**	**Credits/ Hours**
Major-2 Theory	**SC2M26DSCCMAT102**	**Mathematics Analysis-II**	**50 / 50 / 100**	**4 / 4**

Course Outcome	
1	Analyze continuity and related properties of real-valued functions on metric spaces, including compactness, connectedness, monotonicity, and discontinuities.
2	Apply the concept of differentiability and the fundamental results of differential calculus, including mean value theorems, L'Hospital's rule, and Taylor's theorem, to study the behavior of real functions.
3	Examine the definition, existence, and properties of the Riemann–Stieltjes integral and use it in the study of integration, differentiation, and rectifiable curves.
4	Investigate sequences and series of functions with emphasis on pointwise and uniform convergence, and apply these ideas to continuity, integration, differentiation, and approximation theorems such as the Stone–Weierstrass theorem.

Unit	Detail Contents	Hours
1	Continuity: Limits and continuity of functions on metric spaces, Continuity and compactness, continuity and connectedness, discontinuity, monotonic functions, infinite limits and limits at infinity.	**15**
2	Differentiability: The derivative of real functions, Mean-value theorems, continuity of derivatives, L'Hospital's rule, Derivative of higher order, Taylor's theorem.	**15**
3	Riemann–Stieltjes integral: Definition, existence, and properties of the Riemann–Stieltjes integral. Integration and differentiation, Integration of vector-valued functions. Rectifiable curves.	**15**
4	Sequences and series of functions: pointwise and uniform convergence; uniform convergence and continuity, integration, differentiation; Stone–Weierstrass theorem.	**15**

Text Books:	
1	Principles of Mathematical Analysis by Walter Rudin, 3rd Edition, McGraw-Hill Education, ISBN: 978-0070542358

Reference Books:	
1	Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert, 4th Edition, John Wiley & Sons, ISBN: 978-0471433316.
2	Real Analysis by S. C. Malik and Savita Arora, New Age International Publishers, ISBN: 978-8122426472.
3	Mathematical Analysis by Tom M. Apostol, 2nd Edition, Addison-Wesley Publishing Company, ISBN: 978-0201002881.
4	A First Course in Real Analysis by Sterling K. Berberian, Springer, ISBN: 978-0387904047.

Faculty:	Science	Program:	(M.Sc.) Two Year Post Graduate Programme	
Subject:	**Mathematics**	**Semester:**	**1**	
Course Type	**Course Code**	**Course Name**	**Internal / External / Total Marks**	**Credits/ Hours**
Major-3 Theory	**SC2M26DSCCMAT103**	**Complex Analysis**	**50 / 50 / 100**	**4 / 4**
Course Outcome				
1	Analyze continuity, differentiability, and analyticity of complex functions and apply the Cauchy–Riemann equations to study harmonic functions.			
2	Evaluate complex line integrals and contour integrals, and apply Cauchy–Goursat theorem in the analysis of analytic functions.			
3	Apply Cauchy's integral formula and related results to obtain Taylor and Laurent series expansions and to study properties of analytic functions.			
4	Examine singularities, poles, and residues of complex functions, and use the residue theorem for the evaluation of contour integrals.			
Unit	**Detail Contents**			**Hours**
1	[Revision: Complex numbers, polar form and exponential form of complex numbers, powers and roots of complex numbers.] Regions in the complex plane. Continuity and differentiability of complex functions. Analytic functions. Cauchy–Riemann equations. Harmonic functions of two variables. Infinite series of complex numbers and power series functions.			**15**
2	Elementary functions of a complex variable: exponential, trigonometric, hyperbolic, and logarithmic functions. Branches of the logarithmic function. Rectifiable arcs. Complex line integrals and contour integrals. Cauchy–Goursat Theorem.			**15**
3	Cauchy's Integral Formula and its applications. Derivatives of analytic functions. Morera's Theorem. Liouville's Theorem. Fundamental Theorem of Algebra. Taylor series and Laurent series expansions.			**15**
4	Singularities of analytic functions. Zeros of analytic functions. Poles and residues. Residue Theorem. Evaluation of residues at poles and applications.			**15**
Text Books:				
1	Complex Variables and Applications by Ruel V. Churchill and James Ward Brown, 4th Edition, McGraw-Hill International Editions, ISBN: 978-0-07-010855-4.			
Reference Books:				
1	The Elements of Complex Analysis by John Duncan, John Wiley & Sons Ltd., London, ISBN: 978-0471221708.			
2	Complex Analysis by Lars V. Ahlfors, 3rd Edition, McGraw-Hill Book Company, ISBN: 978-0070006577.			
3	Functions of One Complex Variable I by John B. Conway, 2nd Edition, Springer-Verlag, New York, ISBN: 978-0387903286.			
4	Complex Analysis by Serge Lang, 4th Edition, Springer, ISBN: 978-0387985923.			
5	The Elements of Complex Analysis by B. Choudhary, 2nd Edition, New Age International Publishers, New Delhi, ISBN: 978-8122403275.			

Faculty:	**Science**	**Program:**	**(M.Sc.) Two Year Post Graduate Programme**		
Subject:	**Mathematics**	**Semester:**	**1**		
Course Type	**Course Code**	**Course Name**		**Internal / External / Total Marks**	**Credits/ Hours**
Major-3 Practical	**SC2M26PDSCCMAT104**	**MATLAB Programming in Numerical Methods**		**50 / 50 / 100**	**4 / 4**

Course Outcome

1	Apply MATLAB programming techniques to implement numerical methods for finding roots of algebraic and transcendental equations.
2	Solve systems of linear equations and perform matrix computations using direct and iterative numerical methods in MATLAB.
3	Construct interpolation polynomials and approximate numerical values using standard interpolation techniques.
4	Evaluate definite integrals numerically by implementing appropriate quadrature rules in MATLAB.

List of Practical:

1	To write a MATLAB program for finding the root of an equation using the **Bisection Method**.
2	To write a MATLAB program for finding the root of an equation using the **Regula–Falsi Method (False Position Method)**.
3	To write a MATLAB program for finding the root of an equation using the **Newton–Raphson Method**.
4	To write a MATLAB program for finding the root of an equation using the **Secant Method**.
5	To write a MATLAB program for finding the **inverse of a matrix**.
6	To write a MATLAB program for solving a system of linear equations using the **Gauss Elimination Method**.
7	To write a MATLAB program for solving a system of linear equations using the **Gauss–Jordan Elimination Method**.
8	To write a MATLAB program for solving a system of linear equations using the **Jacobi Iterative Method**.
9	To write a MATLAB program for solving a system of linear equations using the **Gauss–Seidel Iterative Method**.
10	To write a MATLAB program for the **Newton Forward Interpolation Formula**
11	To write a MATLAB program for the **Newton Backward Interpolation Formula**.
12	To write a MATLAB program for the **Newton Divided Difference Interpolation Formula**
13	To write a MATLAB program for the **Lagrange Interpolation Formula.**
14	To write a MATLAB program for evaluating integrals using the **Trapezoidal Rule.**
15	To write a MATLAB program for evaluating integrals using **Simpson's 1/3 Rule**.
16	To write a MATLAB program for evaluating integrals using **Simpson's 3/8 Rule**.

Text Books:

1	Numerical Methods in Engineering & Science with Programs in C, C++ & MATLAB *by* B.S. Grewal, Khanna Publication, 978-81-7409-248-9.

Reference Books:

1	Numerical Methods for Engineers *by* Steven C. Chapra and Raymond P. Canale, McGraw-Hill Education, ISBN: 978-1-260-57138-7.

2	Applied Numerical Methods with MATLAB for Engineers and Scientists *by* Steven C. Chapra, McGraw-Hill Education, ISBN: 978-0-07-339796-2 (4th Edition).
3	Numerical Methods for Scientific and Engineering Computation *by* M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Publishers, ISBN: 978-81224-2001-0.
4	An Introduction to Numerical Analysis *by* Kendall E. Atkinson, John Wiley & Sons, ISBN: 978-0-471-62489-9.

Faculty:	Science	Program:	(M.Sc.) Two Year Post Graduate Programme	
Subject:	Mathematics	Semester:	1	
Course Type	Course Code	Course Name	Internal / External / Total Marks	Credits/ Hours
Minor-1 Theory	SC2M26MDCMAT105	Statistical Methods	25 / 25 / 50	2 / 4

Course Outcome

1	Apply descriptive statistical measures and correlation techniques to summarize, analyze, and interpret data.
2	Use the concepts of probability, random variables, and standard probability distributions to solve elementary statistical problems.

Unit	Detail Contents	Hours
1	[Revision: Measures of Location – Mean, Median, and Mode.] Percentiles and Quartiles. Measures of Variability: Range, Interquartile Range, Variance, Standard Deviation, and Coefficient of Variation. Measures of Distribution Shape. Relative Location and Detection of Outliers. Measures of Association between Two Variables: Covariance and Correlation.	15
2	[Revision: Basic Probability Concepts – Methods of Assigning Probability, Events and their Probabilities, Addition Rule, Conditional Probability, Multiplication Rule, and Bayes' Theorem (Statement Only).] Random Variables: Discrete and Continuous Random Variables. Expected Value and Variance of a Random Variable. Probability Distributions: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution, Uniform Distribution, Normal Distribution, Normal Approximation to the Binomial Distribution, and Exponential Distribution. Relationship between Poisson and Exponential Distributions	15

Text Books:

1	Statistical Methods *by* S. P. Gupta, Sultan Chand & Sons, ISBN: 978-81-8054-857-4.

Reference Books:

1	Statistics for Business and Economics by David R. Anderson, Dennis J. Sweeney, and Thomas A. Williams, 9th Edition, Cengage Learning, ISBN: 978-0-324-22320-5.
2	Business Statistics Using Excel by Glyn Davis and Branko Pecar, Oxford University Press (Indian Edition), ISBN: 978-0-19-568567-1.
3	Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons, ISBN: 978-81-8054-791-1.
4	Statistics for Management and Economics by Gerald Keller, Cengage Learning, ISBN: 978-1-337-09074-2.

Faculty:	Science	Program:	(M.Sc.) Two Year Post Graduate Programme	
Subject:	**Mathematics**	**Semester:**	**1**	
Course Type	**Course Code**	**Course Name**	**Internal / External / Total Marks**	**Credits/ Hours**
Minorr-2 Practical	**SC2M26PMDCMAT106**	**MATLAB Programming in Ordinary Differential Equations**	**25 / 25 / 50**	**2 / 4***

Course Outcome

1	Apply MATLAB programming to implement numerical methods for solving first-order ordinary differential equations.
2	Compare and analyze approximate numerical solutions obtained by Euler-type, Runge–Kutta, and predictor–corrector methods for ordinary differential equations.

List of Practical:

1	To write a MATLAB program for solving a first-order ordinary differential equation using **Picard's Method.**
2	To write a MATLAB program for solving a first-order ordinary differential equation using the **Taylor Series Method**.
3	To write a MATLAB program for solving a first-order ordinary differential equation using **Euler's Method.**
4	To write a MATLAB program for solving a first-order ordinary differential equation using the **Modified Euler's Method.**
5	To write a MATLAB program for solving a first-order ordinary differential equation using the **Improved Euler's Method.**
6	To write a MATLAB program for solving a first-order ordinary differential equation using the **Second-Order Runge–Kutta Method (RK2)**.
7	To write a MATLAB program for solving a first-order ordinary differential equation using the **Third-Order Runge–Kutta Method (RK3)**.
8	To write a MATLAB program for solving a first-order ordinary differential equation using the **Fourth-Order Runge–Kutta Method (RK4)**.
9	To write a MATLAB program for solving a first-order ordinary differential equation using the **Adams Predictor–Corrector Method.**

Text Books:

1	Numerical Methods in Engineering & Science with Programs in C, C++ & MATLAB by B.S. Grewal, Khanna Publication, 978-81-7409-248-9

Reference Books:

1	Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale, McGraw-Hill Education, ISBN: 978-1-260-57138-7
2	Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven C. Chapra, McGraw-Hill Education, ISBN: 978-0-07-339796-2 (4th Edition).
3	Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Publishers, ISBN: 978-81224-2001-0.
4	An Introduction to Numerical Analysis by Kendall E. Atkinson, John Wiley & Sons, ISBN: 978-0-471-62489-9.

<table>
<tr><td>Faculty:</td><td>Science</td><td>Program:</td><td colspan="2">(M.Sc.) Two Year Post Graduate Programme</td></tr>
<tr><td>Subject:</td><td>Mathematics</td><td>Semester:</td><td colspan="2">1</td></tr>
<tr><td>Course Type</td><td>Course Code</td><td>Course Name</td><td>Internal / External / Total Marks</td><td>Credits/ Hours</td></tr>
<tr><td>VAC-1 Theory</td><td>SC2M26VACMAT107</td><td>Integral Transforms</td><td>25 / 25 / 50</td><td>2 / 2</td></tr>
</table>

Course Outcomes	
1	Apply Laplace transform techniques, including inverse transforms and convolution theorem, to solve ordinary differential equations.
2	Use Fourier transforms and their properties to analyze functions and solve boundary value problems.

Unit	**Detail Contents**	**Hours**
1	Definition of the Laplace Transform and its properties. Rules of manipulation. Laplace transforms of derivatives and integrals. Inverse Laplace Transform and its properties. Convolution Theorem. Complex Inversion Formula. Applications of Laplace transforms in solving ordinary differential equations.	**15**
2	Definition and properties of Fourier Transforms. Fourier Sine Transform, Fourier Cosine Transform, and Complex Fourier Transform. Convolution Theorem and Inversion Theorems. Fourier transforms of derivatives. Applications of Fourier transforms in solving boundary value problems.	**15**

Reference Books:

1	The Fourier Transform and Its Applications by Ronald N. Bracewell, 3rd Edition, McGraw-Hill Education, ISBN: 978-0073039381.
2	Schaum's Outline of Fourier Analysis with Applications to Boundary Value Problems by Murray R. Spiegel, Schaum's Outline Series, McGraw-Hill Education, ISBN: 978-0070602199.
3	The Laplace Transform: Theory and Applications by Joel L. Schiff, Springer-Verlag, ISBN: 978-0387954486.
4	Schaum's Outline of Laplace Transforms by Murray R. Spiegel, Schaum's Outline Series, McGraw-Hill Education, ISBN: 978-0070602311
5	Integral Transforms and Their Applications by Lokenath Debnath and Dambaru Bhatta, 3rd Edition, Chapman & Hall/CRC Press, ISBN: 978-1466514751.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN- 384265

Faculty of Science

M. Sc. Zoology (Two-year course)

Syllabus/ scheme

(With Coursework)

Semester – 1 to 4

With effect from

June-2026

Date: 27/05/2026 Total page: 21

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Zoology) Syllabus 2026 (according to NEP-2020)	
Document code	**Syllabus ZOO- 2026**
Name of faculty	**Science**
Faculty code	**SCI**
Programme name	**M. Sc. ZOOLOGY**
Programme code	**SCIPG-104**
Effective from	**June-2026**

The proposed new structure for M. Sc. course is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This Programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the Programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q. 3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q. 4	10	Must be drawn from Unit 4 and will have three longs questions out of which any two must be answered (5 marks each).
Q. 5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three longs questions out of which any two must be answered (5 marks each).
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q. 3	05	08 short questions must be drawn from both units, out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMME OBJECTIVE

1. The primary objective of the programme is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Zoology with different specializations.
3. To facilitate higher education & research in Zoology.
4. To provide quality education, offering skill-based programmes and motivating the students for self-employment in applied branches of Zoology.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. The programme also works across related majors within the M.Sc. Zoology.
2. To understand complex physiology, immunology, endocrinology, development biology and evolution of different animals
3. For instance, if you major in Zoology, you can also still take courses from across the other complementary.
4. Master of Science majors in conservation biology and ecology, giving you an in-depth knowledge of those most closely related programmes.
5. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as health sciences, aquaculture, agriculture, environmental management, biotechnology, publishing, teaching and research.
6. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
7. Understand the applications of biological techniques to various fields of biology.
8. When you graduate with a Master of Science (Zoology) you will have learned how to work at a high level of academic achievement.
9. Work to deadlines under pressure and communicate effectively.

M. Sc. Semester I (Zoology)

M. Sc. with coursework								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSCC ZOO101	Ethology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCC ZOO102	Regulatory Biology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCC ZOO103	Histology and Parasitology	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSCCZ OO104	Practical (Ethology, Regulatory Biology, Histology and Parasitology)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MDC ZOO105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course Practical Paper	SC2M26PMD CZOO106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VAC ZOO107	Aquaculture	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO101

ETHOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Programme Outcome:

1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. To understand the basic concepts of animal behaviour.
2. To develop knowledge of learning behaviour in animals.
3. To develop knowledge of orientation in animals.
4. To develop knowledge of role of pheromones and hormones in animal behaviour.

Sr. No			Credit	Hr.
1	Unit-1	• Introduction and history of animal behaviour. • Concepts of animal behaviour. • Imprinting animals. • Approaches and methods to study animal behavior and role of sense organs in behaviour.	1	15
2	Unit-2	• Learning behaviour: types and neural mechanisms. • Aggressive behaviour: types, causes and hormonal control. • Territorial behaviour: types, functions and methods. • Parental care: types and affecting factors.	1	15

3	**Unit-3**	• Orientation in animals: types, kinesis and taxes. • Feeding strategies in animals. • Types of communication: auditory, visual, chemical and tactile. • Social organization in mammals.	**1**	**15**
4	**Unit-4**	• Role of pheromones in animal behaviour. • Role of hormones in animal behaviour. • Biological clocks. • Human ethology.	**1**	**15**

References:

1. Alcock J. 2013 Animal behaviour: An Evolutionary Approach, 10th edition (Sinauer Associates, Inc.).
2. Bolhuis J. J. and Giraldeau L. (eds) 2005 The behaviour of animals (Blackwell Pub.).
3. Breed and Moore 2011 Animal behaviour, 1st Edition (Academic Press).
4. Mathur R. 2008 Animal behaviour (Rastogi Pub.: India).
5. Manning A. and Dawkins M. S. 1997 An Introduction to animal behaviour (4th edition).
6. Sherman P. W. and Alcock J. 1997 Exploring animal behaviour (Sinauer Asso. Inc. Pub.: Sunderland, Massachusetts).
7. Slater P. J. B. 1999 Essentials of animal behaviour (Cambridge Uni. Press).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO102

REGULATORY BIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:
1. To develop knowledge of immunity and organs associated with immunity.
2. To develop knowledge of the reactions and pathways of immune system.
3. To develop knowledge of endocrinology.
4. To develop knowledge of hormones and associated organs.

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Introduction and history of immunology. • Organs and cells of immune system. • Antigen, antibody and their reactions. • Types of immunity- innate, adaptive, humoral mediated and cell mediated.	**1**	**15**
2	**Unit-2**	• Complement system: classical and alternative pathways. • Major histocompatibility complex (MHC) structure and function. • Cytokines and cytokine receptors. • hypersensitivity and autoimmune diseases. • AIDS	**1**	**15**
3	**Unit-3**	• Brief history of endocrinology. • Hormones and neuroendocrine integration in homeostasis. • Hormone synthesis. • Hormone circulation and metabolism.	**1**	**15**

4	**Unit-4**	• Nervous system hormones (hypothalamus, pituitary and pineal). • Thyroid and parathyroid gland and its hormones. • Pancreas and its hormones. • Adrenal gland and its hormones, reproductive hormones. • Gastro-Intestinal hormones and their functions.	**1**	**15**

References:

1. Richard, Thomas, Barbara, Janis (2005) Kuby Immunology, W. H. Freeman and company, New York, USA.
2. Janeway, Travers, Walport and Shlomchik (2005) Immuno Biology- The immune system in health and disease, Garland Science Publishing, New York, USA.
3. David, Brostoff and Roitt (2006) Immunology, (7^{th} Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.
4. Mac Hadley. 1992. Endocrinology, 3 rd Edition. Prentice – Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
5. Ingleton, P.M. and Bangara, J.T. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
6. Turner, C.D. and Bangara, J.T. 1986. General Endocrinology. Saunders International Student edition. Toppan Company Limited, Tokyo.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO103

HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Programme Outcome:

1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. To develop basic knowledge of histology.
2. To develop understanding of different types of tissues and their histology.
3. To develop basic knowledge of Parasitology.
4. To develop basic knowledge of parasitic organisms.

Sr. No			Credit	Hr.
1	Unit-1	• Introduction to Histology and Histochemistry. • Tissue processing, fixation and microtomy. • Staining methods: acid, basic, neutral and vital stains and various histochemical stains. • Staining of frozen and paraffin sections.	1	15
2	Unit-2	• Introduction to types of body tissue. • Histology of epithelial tissue and connective tissue. • Histology of muscle, bones and cartilage. • Histology of digestive system tissues (tongue, oesophagus, stomach, large intestine, pancreas, liver) and nervous tissue.	1	15
3	Unit-3	• Introduction parasitology. • Types of hosts and parasites. • Food and water-borne bacterial diseases. • Sexually transmitted bacterial diseases.	1	15

4	**Unit-4**	• Parasitic protozoans and human diseases • Parasitic trematoda, cestoda and human diseases • Parasitic nematode and human diseases • Parasitic mites, ticks and their control	**1**	**15**

References:

1. Bloom and Fawcett. D. 1972 Textbook of histology 10th ed. 3.
2. David H.C. 1987 Histology 9th ed. (Horper International Pub).
3. McManus J.F.A. and Mowry R.W. 1960 Staining methods.
4. Cheng T.C. (1964) The Biology of animal parasites, Saunders International Student Edition
5. Panikar C.K.J (1988) 5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh.
6. Sood Pamnik (1993) Parasitology (Protozoology and Helminthology) CBS Publication and Distrubution, Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCZOO104

ETHOLOGY, REGULATORY BIOLOGY, HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

<u>List of Practicals</u>

1. Study of mudballing behaviour of burrowing crab.
2. To study food preference in *Tribolium castaneum*.
3. To study the different types of receptors in *Tribolium castaneum*.
4. To study location of receptors by antennalectomy in *Tribolium castaneum*.
5. Determination of blood group of given blood sample.
6. Histology of lymphoid organs using permanent slides/charts.
7. Introduction to instrumentation and immunological test carried out in pathology laboratory.
8. To study location and function of endocrine glands in animal body using charts.
9. To study histology of pituitary, pineal, thyroid, and parathyroid gland using charts/slides.
10. To study histology of pancreas, thymus and adrenal gland using charts/slides.
11. To study histology of testes and ovary using charts/slides.
12. To study various endocrine disorders using slides/charts.
13. Study of different types of microtomes.
14. To study different methods of tissue processing and staining techniques for histological analysis.
15. To study histological structure of different types of epithelial, and muscle tissue using permanent slides.
16. To study histological structure of bone and cartilage using permanent slides.
17. To prepare the permanent slides of different tissues (epithelial tissues, cartilage, and bone, muscle tissue).
18. To prepare the permanent slides of different tissues (Esophagus, Trachea, Stomach, Intestine, Liver, Kidney, Testis, Ovary).
19. Study of histopathological changes in normal and affected tissue: Carcinoma, Tuberculosis, Liver cirrhosis, Fatty liver, Alzheimer's disease.
20. Study of parasitic protozoan causing disease in humans.
21. Study of parasitic platyhelmithes, nematods, mites and ticks and causing diseases in humans.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCZOO105

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Programme Outcome: 1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology. 2. This programme will help students acquire laboratory, microscopy, and aquaculture skills. 3. This programme will help students apply research design, data analysis, and scientific methods. 4. This programme will help students build scientific, ethical, and professional competencies in zoology.
Course Outcome: After thorough understanding of the content student will be able to explain: 1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests. 2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student's t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit.	1	15

2	**Unit-2**	● Introduction to research methodology, type of research, research method vs methodology. ● Research process, type of sampling design, and methods of data collection. ● Scientific deliveries and communications: writing research proposal, paper, thesis, and report. ● Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. ● Publication processes, review processes and significance of scientific communications.	**1**	**15**

References:

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCZOO106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student's t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
VALUE ADDED COURSE CODE: SC2M26VACZOO107

AQUACULTURE

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	**(02 Period/Week)**	**Internal-25 Marks**	**External-25 Marks**	**External 25 Marks Internal 25 Marks**

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology. 2. This programme will help students acquire laboratory, microscopy, and aquaculture skills. 3. This programme will help students apply research design, data analysis, and scientific methods. 4. This programme will help students build scientific, ethical, and professional competencies in zoology.
Course Outcome:
After thorough understanding of the content student will be able to explain: 1. To understand the basic concepts of fisheries in India. 2. To develop knowledge regarding various practices of aquaculture.

Unit	Content	Credit	Hours
I	• History, scope and types and status of aquacultures in India. • Fishing methods, crafts and gears. • Cultivable fauna and flora in aquaculture. • Fisheries research institutes in India.	01	15
II	• Composite fish culture and poly culture. • Integrated fish farming, sewage fed fish culture, cage culture, and pen culture. • Freshwater fish culture, induce breeding and preservation of fish. • Pearl culture, Prawn culture, Mussel farming in India.	01	15

References:

1. Friedrich, H.: Marine Biology.
2. Raymont, J.E.C.: Plankton and productivity in the Oceans, Volume 1. 3. Balakrishna Nair. N. and D.M.
3. Inland Fishes of India and Adjacent Countries by P.K. Talwar & V.G. Jhingran.
4. FAO Species Identification Sheets (Western Indian Ocean/Eastern Indian Ocean).
5. Fishes – An Introduction to Ichthyology by P.S. Moyle.
6. Fish and Fisheries, B. N. Yadav, Daya Publication.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCZOO104

ETHOLOGY, REGULATORY BIOLOGY, HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Analyze the mud balling pattern of crab from given figures and comments on its merits of getting selected by female on the basis of mud balling parameters **OR** Practical related to *Tribolium castenium.*	**09**
Q2		Determination of blood group **OR** Location and function of endocrine gland **OR** Histological structure of lymphoid organ/endocrine gland.	**09**
Q3		Identify type of microtome and describe its working procedure **OR** Perform fixation and staining of given tissue section.	**09**
Q4		Do as directed. 1. Identify and describe pathogenicity of given specimen. 2. Identify the endocrine disorder and describe its symptoms. 3. Identify the instrument used in pathology laboratory and describe its use.	**09**
Q5	**a**	Submission of slide box.	**06**
	b	Journal	**03**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PMDCZOO106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Perform parametric test for the given dataset (Student's test, Anova, Simple linear regression and Correlation analysis).	**05**
Q2		Perform non-parametric test for the given dataset (Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit).	**05**
Q3		Practical regarding references management system/reference formatting.	**05**
Q4		Project proposal submission.	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN- 384265

Faculty of Science

M. Sc. Zoology (Two-year course)

Syllabus/ scheme

(Coursework with Research)

Semester – 1 to 4

With effect from

June-2026

Date: 27/05/2026 Total page: 21

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Zoology) Syllabus 2026 (according to NEP-2020)	
Document code	Syllabus ZOO- 2026
Name of faculty	Science
Faculty code	SCI
Programme name	M. Sc. ZOOLOGY
Programme code	SCIPG-104
Effective from	June-2026

The proposed new structure for M. Sc. course is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q. 3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q. 4	10	Must be drawn from Unit 4 and will have three longs questions out of which any two must be answered (5 marks each).
Q. 5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three longs questions out of which any two must be answered (5 marks each).
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q. 3	05	08 short questions must be drawn from both units, out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMME OBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Zoology with different specializations.
3. To facilitate higher education & research in Zoology.
4. To provide quality education, offering skill-based programmes and motivating the students for self-employment in applied branches of Zoology.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. The programme also works across related majors within the M.Sc. Zoology.
2. To understand complex physiology, immunology, endocrinology, development biology and evolution of different animals
3. For instance, if you major in Zoology, you can also still take courses from across the other complementary.
4. Master of Science majors in conservation biology and ecology, giving you an in-depth knowledge of those most closely related programmes.
5. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as health sciences, aquaculture, agriculture, environmental management, biotechnology, publishing, teaching and research.
6. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
7. Understand the applications of biological techniques to various fields of biology.
8. When you graduate with a Master of Science (Zoology) you will have learned how to work at a high level of academic achievement.
9. Work to deadlines under pressure and communicate effectively.

M. Sc. Semester I (Zoology)

M. Sc. with Coursework with Research

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Discipline Specific core course	SC2M26DSCC ZOO101	Ethology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCC ZOO102	Regulatory Biology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCC ZOO103	Histology and Parasitology	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSCCZ OO104	Practical (Ethology, Regulatory Biology, Histology and Parasitology)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MDC ZOO105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course Practical Paper	SC2M26PMD CZOO106	Research Design and Data Analysis	4	25	25	50	2	3
Vocational Course	SC2M26VO C ZOO107	Aquaculture	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO101

ETHOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04	**(04 Period/Week)**	**Theory**	**External-50 Marks**
			Internal- 50 Marks

Programme Outcome:

1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. To understand the basic concepts of animal behaviour.
2. To develop knowledge of learning behaviour in animals.
3. To develop knowledge of orientation in animals.
4. To develop knowledge of role of pheromones and hormones in animal behaviour.

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Introduction and history of animal behaviour. • Concepts of animal behaviour. • Imprinting animals. • Approaches and methods to study animal behavior and role of sense organs in behaviour.	**1**	**15**
2	**Unit-2**	• Learning behaviour: types and neural mechanisms. • Aggressive behaviour: types, causes and hormonal control. • Territorial behaviour: types, functions and methods. • Parental care: types and affecting factors.	**1**	**15**

3	**Unit-3**	• Orientation in animals: types, kinesis and taxes. • Feeding strategies in animals. • Types of communication: auditory, visual, chemical and tactile. • Social organization in mammals.	**1**	**15**
4	**Unit-4**	• Role of pheromones in animal behaviour. • Role of hormones in animal behaviour. • Biological clocks. • Human ethology.	**1**	**15**

References:

1. Alcock J. 2013 Animal behaviour: An Evolutionary Approach, 10th edition (Sinauer Associates, Inc.).
2. Bolhuis J. J. and Giraldeau L. (eds) 2005 The behaviour of animals (Blackwell Pub.).
3. Breed and Moore 2011 Animal behaviour, 1st Edition (Academic Press).
4. Mathur R. 2008 Animal behaviour (Rastogi Pub.: India).
5. Manning A. and Dawkins M. S. 1997 An Introduction to animal behaviour (4th edition).
6. Sherman P. W. and Alcock J. 1997 Exploring animal behaviour (Sinauer Asso. Inc. Pub.: Sunderland, Massachusetts).
7. Slater P. J. B. 1999 Essentials of animal behaviour (Cambridge Uni. Press).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO102

REGULATORY BIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Programme Outcome:

1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. To develop knowledge of immunity and organs associated with immunity.
2. To develop knowledge of the reactions and pathways of immune system.
3. To develop knowledge of endocrinology.
4. To develop knowledge of hormones and associated organs.

Sr. No			Credit	Hr.
1	Unit-1	• Introduction and history of immunology. • Organs and cells of immune system. • Antigen, antibody and their reactions. • Types of immunity- innate, adaptive, humoral mediated and cell mediated.	1	15
2	Unit-2	• Complement system: classical and alternative pathways. • Major histocompatibility complex (MHC) structure and function. • Cytokines and cytokine receptors. • hypersensitivity and autoimmune diseases. • AIDS	1	15
3	Unit-3	• Brief history of endocrinology. • Hormones and neuroendocrine integration in homeostasis. • Hormone synthesis. • Hormone circulation and metabolism.	1	15

4	**Unit-4**	• Nervous system hormones (hypothalamus, pituitary and pineal). • Thyroid and parathyroid gland and its hormones. • Pancreas and its hormones. • Adrenal gland and its hormones, reproductive hormones. • Gastro-Intestinal hormones and their functions.	**1**	**15**

References:

1. Richard, Thomas, Barbara, Janis (2005) Kuby Immunology, W. H. Freeman and company, New York, USA.
2. Janeway, Travers, Walport and Shlomchik (2005) Immuno Biology- The immune system in health and disease, Garland Science Publishing, New York, USA.
3. David, Brostoff and Roitt (2006) Immunology, (7th Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.
4. Mac Hadley. 1992. Endocrinology, 3 rd Edition. Prentice – Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
5. Ingleton, P.M. and Bangara, J.T. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
6. Turner, C.D. and Bangara, J.T. 1986. General Endocrinology. Saunders International Student edition. Toppan Company Limited, Tokyo.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO103

HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:
1. To develop basic knowledge of histology.
2. To develop understanding of different types of tissues and their histology.
3. To develop basic knowledge of Parasitology.
4. To develop basic knowledge of parasitic organisms.

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Introduction to Histology and Histochemistry. • Tissue processing, fixation and microtomy. • Staining methods: acid, basic, neutral and vital stains and various histochemical stains. • Staining of frozen and paraffin sections.	**1**	**15**
2	**Unit-2**	• Introduction to types of body tissue. • Histology of epithelial tissue and connective tissue. • Histology of muscle, bones and cartilage. • Histology of digestive system tissues (tongue, oesophagus, stomach, large intestine, pancreas, liver) and nervous tissue.	**1**	**15**
3	**Unit-3**	• Introduction parasitology. • Types of hosts and parasites. • Food and water-borne bacterial diseases. • Sexually transmitted bacterial diseases.	**1**	**15**

4	**Unit-4**	• Parasitic protozoans and human diseases • Parasitic trematoda, cestoda and human diseases • Parasitic nematode and human diseases • Parasitic mites, ticks and their control	**1**	**15**

References:
1. Bloom and Fawcett. D. 1972 Textbook of histology 10th ed. 3.
2. David H.C. 1987 Histology 9th ed. (Horper International Pub).
3. McManus J.F.A. and Mowry R.W. 1960 Staining methods.
4. Cheng T.C. (1964) The Biology of animal parasites, Saunders International Student Edition
5. Panikar C.K.J (1988) 5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh.
6. Sood Pamnik (1993) Parasitology (Protozoology and Helminthology) CBS Publication and Distrubution, Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCZOO104

ETHOLOGY, REGULATORY BIOLOGY, HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. Study of mudballing behaviour of burrowing crab.
2. To study food preference in *Tribolium castaneum*.
3. To study the different types of receptors in *Tribolium castaneum*.
4. To study location of receptors by antennalectomy in *Tribolium castaneum*.
5. Determination of blood group of given blood sample.
6. Histology of lymphoid organs using permanent slides/charts.
7. Introduction to instrumentation and immunological test carried out in pathology laboratory.
8. To study location and function of endocrine glands in animal body using charts.
9. To study histology of pituitary, pineal, thyroid, and parathyroid gland using charts/slides.
10. To study histology of pancreas, thymus and adrenal gland using charts/slides.
11. To study histology of testes and ovary using charts/slides.
12. To study various endocrine disorders using slides/charts.
13. Study of different types of microtomes.
14. To study different methods of tissue processing and staining techniques for histological analysis.
15. To study histological structure of different types of epithelial, and muscle tissue using permanent slides.
16. To study histological structure of bone and cartilage using permanent slides.
17. To prepare the permanent slides of different tissues (epithelial tissues, cartilage, and bone, muscle tissue).
18. To prepare the permanent slides of different tissues (Esophagus, Trachea, Stomach, Intestine, Liver, Kidney, Testis, Ovary).
19. Study of histopathological changes in normal and affected tissue: Carcinoma, Tuberculosis, Liver cirrhosis, Fatty liver, Alzheimer's disease.
20. Study of parasitic protozoan causing disease in humans.
21. Study of parasitic platyhelmithes, nematods, mites and ticks and causing diseases in humans.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCZOO105

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Programme Outcome:

1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	• Definition and scope of biostatistics, different types of graphs. • Measures of central tendency, standard deviation, and standard error. • Statistical significance: hypothesis testing, types of error, level of significance. • Parametric test: student’s t test, Anova, simple linear regression and correlation analysis. • Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit.	1	15

2	**Unit-2**	● Introduction to research methodology, type of research, research method vs methodology. ● Research process, type of sampling design, and methods of data collection. ● Scientific deliveries and communications: writing research proposal, paper, thesis, and report. ● Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. ● Publication processes, review processes and significance of scientific communications.	**1**	**15**

References:

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCZOO106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student's t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
VALUE ADDED COURSE CODE: SC2M26VACZOO107

AQUACULTURE

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	(02 Period/Week)	Internal-25 Marks	External-25 Marks	External 25 Marks Internal 25 Marks

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology. 2. This programme will help students acquire laboratory, microscopy, and aquaculture skills. 3. This programme will help students apply research design, data analysis, and scientific methods. 4. This programme will help students build scientific, ethical, and professional competencies in zoology.
Course Outcome:
After thorough understanding of the content student will be able to explain: 1. To understand the basic concepts of fisheries in India. 2. To develop knowledge regarding various practices of aquaculture.

Unit	Content	Credit	Hours
I	• History, scope and types and status of aquacultures in India. • Fishing methods, crafts and gears. • Cultivable fauna and flora in aquaculture. • Fisheries research institutes in India.	01	15
II	• Composite fish culture and poly culture. • Integrated fish farming, sewage fed fish culture, cage culture, and pen culture. • Freshwater fish culture, induce breeding and preservation of fish. • Pearl culture, Prawn culture, Mussel farming in India.	01	15

References:

1. Friedrich, H.: Marine Biology.
2. Raymont, J.E.C.: Plankton and productivity in the Oceans, Volume 1. 3. Balakrishna Nair. N. and D.M.
3. Inland Fishes of India and Adjacent Countries by P.K. Talwar & V.G. Jhingran.
4. FAO Species Identification Sheets (Western Indian Ocean/Eastern Indian Ocean).
5. Fishes – An Introduction to Ichthyology by P.S. Moyle.
6. Fish and Fisheries, B. N. Yadav, Daya Publication.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCZOO104

ETHOLOGY, REGULATORY BIOLOGY, HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Analyze the mud balling pattern of crab from given figures and comments on its merits of getting selected by female on the basis of mud balling parameters **OR** Practical related to *Tribolium castenium.*	**09**
Q2		Determination of blood group **OR** Location and function of endocrine gland **OR** Histological structure of lymphoid organ/endocrine gland.	**09**
Q3		Identify type of microtome and describe its working procedure **OR** Perform fixation and staining of given tissue section.	**09**
Q4		Do as directed. 1. Identify and describe pathogenicity of given specimen. 2. Identify the endocrine disorder and describe its symptoms. 3. Identify the instrument used in pathology laboratory and describe its use.	**09**
Q5	**a**	Submission of slide box.	**06**
	b	Journal	**03**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PMDCZOO106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Perform parametric test for the given dataset (Student's test, Anova, Simple linear regression and Correlation analysis).	**05**
Q2		Perform non-parametric test for the given dataset (Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit).	**05**
Q3		Practical regarding references management system/reference formatting.	**05**
Q4		Project proposal submission.	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN- 384265

Faculty of Science

M. Sc. Zoology (Two-year course)

Syllabus/ scheme

(With Research)

Semester – 1 to 4

With effect from

June-2026

Date: 27/05/2026 Total page: 21

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Zoology) Syllabus 2026 (according to NEP-2020)	
Document code	Syllabus ZOO- 2026
Name of faculty	Science
Faculty code	SCI
Programme name	M. Sc. ZOOLOGY
Programme code	SCIPG-104
Effective from	June-2026

The proposed new structure for M. Sc. course is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q. 3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q. 4	10	Must be drawn from Unit 4 and will have three longs questions out of which any two must be answered (5 marks each).
Q. 5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three longs questions out of which any two must be answered (5 marks each).
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q. 3	05	08 short questions must be drawn from both units, out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMME OBJECTIVE

1. The primary objective of the programme is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in a branch of biological sciences i.e. Zoology with different specializations.
3. To facilitate higher education & research in Zoology.
4. To provide quality education, offering skill-based programmes and motivating the students for self-employment in applied branches of Zoology.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. The programme also works across related majors within the M.Sc. Zoology.
2. To understand complex physiology, immunology, endocrinology, development biology and evolution of different animals
3. For instance, if you major in Zoology, you can also still take courses from across the other complementary.
4. Master of Science majors in conservation biology and ecology, giving you an in-depth knowledge of those most closely related programmes.
5. Apply the wide range of subject-based skills to various fields that provide a base for future career in disciplines such as health sciences, aquaculture, agriculture, environmental management, biotechnology, publishing, teaching and research.
6. Perform, assess and implement practical techniques and procedures to solve biological problems and analyze and quantify data collected during any project.
7. Understand the applications of biological techniques to various fields of biology.
8. When you graduate with a Master of Science (Zoology) you will have learned how to work at a high level of academic achievement.
9. Work to deadlines under pressure and communicate effectively.

M. Sc. Semester I (Zoology)

M. Sc. with Research								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSCC ZOO101	Ethology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCC ZOO102	Regulatory Biology	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCC ZOO103	Histology and Parasitology	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSCCZ OO104	Practical (Ethology, Regulatory Biology, Histology and Parasitology)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MDC ZOO105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course Practical Paper	SC2M26PMD CZOO106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VAC ZOO107	Aquaculture	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO101

ETHOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:
1. To understand the basic concepts of animal behaviour.
2. To develop knowledge of learning behaviour in animals.
3. To develop knowledge of orientation in animals.
4. To develop knowledge of role of pheromones and hormones in animal behaviour.

Sr. No			Credit	Hr.
1	Unit-1	• Introduction and history of animal behaviour. • Concepts of animal behaviour. • Imprinting animals. • Approaches and methods to study animal behavior and role of sense organs in behaviour.	1	15
2	Unit-2	• Learning behaviour: types and neural mechanisms. • Aggressive behaviour: types, causes and hormonal control. • Territorial behaviour: types, functions and methods. • Parental care: types and affecting factors.	1	15

3	**Unit-3**	• Orientation in animals: types, kinesis and taxes. • Feeding strategies in animals. • Types of communication: auditory, visual, chemical and tactile. • Social organization in mammals.	**1**	**15**
4	**Unit-4**	• Role of pheromones in animal behaviour. • Role of hormones in animal behaviour. • Biological clocks. • Human ethology.	**1**	**15**

References:

1. Alcock J. 2013 Animal behaviour: An Evolutionary Approach, 10th edition (Sinauer Associates, Inc.).
2. Bolhuis J. J. and Giraldeau L. (eds) 2005 The behaviour of animals (Blackwell Pub.).
3. Breed and Moore 2011 Animal behaviour, 1st Edition (Academic Press).
4. Mathur R. 2008 Animal behaviour (Rastogi Pub.: India).
5. Manning A. and Dawkins M. S. 1997 An Introduction to animal behaviour (4th edition).
6. Sherman P. W. and Alcock J. 1997 Exploring animal behaviour (Sinauer Asso. Inc. Pub.: Sunderland, Massachusetts).
7. Slater P. J. B. 1999 Essentials of animal behaviour (Cambridge Uni. Press).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO102

REGULATORY BIOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology. 2. This programme will help students acquire laboratory, microscopy, and aquaculture skills. 3. This programme will help students apply research design, data analysis, and scientific methods. 4. This programme will help students build scientific, ethical, and professional competencies in zoology.
Course Outcome: After thorough understanding of the content student will be able to explain: 1. To develop knowledge of immunity and organs associated with immunity. 2. To develop knowledge of the reactions and pathways of immune system. 3. To develop knowledge of endocrinology. 4. To develop knowledge of hormones and associated organs.

Sr. No			Credit	Hr.
1	Unit-1	• Introduction and history of immunology. • Organs and cells of immune system. • Antigen, antibody and their reactions. • Types of immunity- innate, adaptive, humoral mediated and cell mediated.	1	15
2	Unit-2	• Complement system: classical and alternative pathways. • Major histocompatibility complex (MHC) structure and function. • Cytokines and cytokine receptors. • hypersensitivity and autoimmune diseases. • AIDS	1	15
3	Unit-3	• Brief history of endocrinology. • Hormones and neuroendocrine integration in homeostasis. • Hormone synthesis. • Hormone circulation and metabolism.	1	15

4	**Unit-4**	• Nervous system hormones (hypothalamus, pituitary and pineal). • Thyroid and parathyroid gland and its hormones. • Pancreas and its hormones. • Adrenal gland and its hormones, reproductive hormones. • Gastro-Intestinal hormones and their functions.	**1**	**15**

References:

1. Richard, Thomas, Barbara, Janis (2005) Kuby Immunology, W. H. Freeman and company, New York, USA.
2. Janeway, Travers, Walport and Shlomchik (2005) Immuno Biology- The immune system in health and disease, Garland Science Publishing, New York, USA.
3. David, Brostoff and Roitt (2006) Immunology, (7^{th} Ed., 2006), Mosby & Elsevier Publishing, Canada, USA.
4. Mac Hadley. 1992. Endocrinology, 3 rd Edition. Prentice – Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
5. Ingleton, P.M. and Bangara, J.T. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
6. Turner, C.D. and Bangara, J.T. 1986. General Endocrinology. Saunders International Student edition. Toppan Company Limited, Tokyo.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCZOO103

HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology. 2. This programme will help students acquire laboratory, microscopy, and aquaculture skills. 3. This programme will help students apply research design, data analysis, and scientific methods. 4. This programme will help students build scientific, ethical, and professional competencies in zoology.
Course Outcome: After thorough understanding of the content student will be able to explain: 1. To develop basic knowledge of histology. 2. To develop understanding of different types of tissues and their histology. 3. To develop basic knowledge of Parasitology. 4. To develop basic knowledge of parasitic organisms.

Sr. No			**Credit**	**Hr.**
1	**Unit-1**	• Introduction to Histology and Histochemistry. • Tissue processing, fixation and microtomy. • Staining methods: acid, basic, neutral and vital stains and various histochemical stains. • Staining of frozen and paraffin sections.	**1**	**15**
2	**Unit-2**	• Introduction to types of body tissue. • Histology of epithelial tissue and connective tissue. • Histology of muscle, bones and cartilage. • Histology of digestive system tissues (tongue, oesophagus, stomach, large intestine, pancreas, liver) and nervous tissue.	**1**	**15**
3	**Unit-3**	• Introduction parasitology. • Types of hosts and parasites. • Food and water-borne bacterial diseases. • Sexually transmitted bacterial diseases.	**1**	**15**

4	**Unit-4**	• Parasitic protozoans and human diseases • Parasitic trematoda, cestoda and human diseases • Parasitic nematode and human diseases • Parasitic mites, ticks and their control	**1**	**15**

References:

1. Bloom and Fawcett. D. 1972 Textbook of histology 10th ed. 3.
2. David H.C. 1987 Histology 9th ed. (Horper International Pub).
3. McManus J.F.A. and Mowry R.W. 1960 Staining methods.
4. Cheng T.C. (1964) The Biology of animal parasites, Saunders International Student Edition
5. Panikar C.K.J (1988) 5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh.
6. Sood Pamnik (1993) Parasitology (Protozoology and Helminthology) CBS Publication and Distrubution, Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCZOO104

ETHOLOGY, REGULATORY BIOLOGY, HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. Study of mudballing behaviour of burrowing crab.
2. To study food preference in *Tribolium castaneum*.
3. To study the different types of receptors in *Tribolium castaneum*.
4. To study location of receptors by antennalectomy in *Tribolium castaneum*.
5. Determination of blood group of given blood sample.
6. Histology of lymphoid organs using permanent slides/charts.
7. Introduction to instrumentation and immunological test carried out in pathology laboratory.
8. To study location and function of endocrine glands in animal body using charts.
9. To study histology of pituitary, pineal, thyroid, and parathyroid gland using charts/slides.
10. To study histology of pancreas, thymus and adrenal gland using charts/slides.
11. To study histology of testes and ovary using charts/slides.
12. To study various endocrine disorders using slides/charts.
13. Study of different types of microtomes.
14. To study different methods of tissue processing and staining techniques for histological analysis.
15. To study histological structure of different types of epithelial, and muscle tissue using permanent slides.
16. To study histological structure of bone and cartilage using permanent slides.
17. To prepare the permanent slides of different tissues (epithelial tissues, cartilage, and bone, muscle tissue).
18. To prepare the permanent slides of different tissues (Esophagus, Trachea, Stomach, Intestine, Liver, Kidney, Testis, Ovary).
19. Study of histopathological changes in normal and affected tissue: Carcinoma, Tuberculosis, Liver cirrhosis, Fatty liver, Alzheimer's disease.
20. Study of parasitic protozoan causing disease in humans.
21. Study of parasitic platyhelmithes, nematods, mites and ticks and causing diseases in humans.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ZOOLOGY SEMESTER I

PROGRAMME CODE: SCIPG-104

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCZOO105

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Programme Outcome:

1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	• Definition and scope of biostatistics, different types of graphs. • Measures of central tendency, standard deviation, and standard error. • Statistical significance: hypothesis testing, types of error, level of significance. • Parametric test: student's t test, Anova, simple linear regression and correlation analysis. • Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit.	1	15

2	**Unit-2**	• Introduction to research methodology, type of research, research method vs methodology. • Research process, type of sampling design, and methods of data collection. • Scientific deliveries and communications: writing research proposal, paper, thesis, and report. • Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. • Publication processes, review processes and significance of scientific communications.	**1**	**15**

References:

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCZOO106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
   a. Arithmetic Mean
   b. Harmonic Mean
   c. Geometric Mean
   d. Median
   e. Mode
2. Computation of various measures of dispersion:
   a. Standard Deviation
   b. Standard error
3. To perform Student’s t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
   a. Sign test
   b. Wilcoxon signed-rank test
   c. Kruskal-Wallis test
   d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
VALUE ADDED COURSE CODE: SC2M26VACZOO107

AQUACULTURE

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	**(02 Period/Week)**	**Internal-25 Marks**	**External-25 Marks**	**External 25 Marks Internal 25 Marks**

Programme Outcome:
1. This programme will help students develop knowledge in animal biology, behaviour, physiology, and parasitology.
2. This programme will help students acquire laboratory, microscopy, and aquaculture skills.
3. This programme will help students apply research design, data analysis, and scientific methods.
4. This programme will help students build scientific, ethical, and professional competencies in zoology.

Course Outcome:
After thorough understanding of the content student will be able to explain:
1. To understand the basic concepts of fisheries in India.
2. To develop knowledge regarding various practices of aquaculture.

Unit	Content	Credit	Hours
I	• History, scope and types and status of aquacultures in India. • Fishing methods, crafts and gears. • Cultivable fauna and flora in aquaculture. • Fisheries research institutes in India.	**01**	**15**
II	• Composite fish culture and poly culture. • Integrated fish farming, sewage fed fish culture, cage culture, and pen culture. • Freshwater fish culture, induce breeding and preservation of fish. • Pearl culture, Prawn culture, Mussel farming in India.	**01**	**15**

References:

1. Friedrich, H.: Marine Biology.
2. Raymont, J.E.C.: Plankton and productivity in the Oceans, Volume 1. 3. Balakrishna Nair. N. and D.M.
3. Inland Fishes of India and Adjacent Countries by P.K. Talwar & V.G. Jhingran.
4. FAO Species Identification Sheets (Western Indian Ocean/Eastern Indian Ocean).
5. Fishes – An Introduction to Ichthyology by P.S. Moyle.
6. Fish and Fisheries, B. N. Yadav, Daya Publication.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCZOO104

ETHOLOGY, REGULATORY BIOLOGY, HISTOLOGY AND PARASITOLOGY

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Analyze the mud balling pattern of crab from given figures and comments on its merits of getting selected by female on the basis of mud balling parameters **OR** Practical related to *Tribolium castenium.*	**09**
Q2		Determination of blood group **OR** Location and function of endocrine gland **OR** Histological structure of lymphoid organ/endocrine gland.	**09**
Q3		Identify type of microtome and describe its working procedure **OR** Perform fixation and staining of given tissue section.	**09**
Q4		Do as directed. 1. Identify and describe pathogenicity of given specimen. 2. Identify the endocrine disorder and describe its symptoms. 3. Identify the instrument used in pathology laboratory and describe its use.	**09**
Q5	**a**	Submission of slide box.	**06**
	b	Journal	**03**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ZOOLOGY SEMESTER I
PROGRAMME CODE: SCIPG-104
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PMDCZOO106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Perform parametric test for the given dataset (Student's test, Anova, Simple linear regression and Correlation analysis).	**05**
Q2		Perform non-parametric test for the given dataset (Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit).	**05**
Q3		Practical regarding references management system/reference formatting.	**05**
Q4		Project proposal submission.	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN-384265

Faculty of Science

M. Sc. Environmental Science
(2 yrs with course work)

Syllabus/ scheme

Semester – 1 to 4

SEMESTER – I
(with course work)

With effect from

June-2026

Date: 12/06/2026 Total page: 25

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Environmental Science) Syllabus 2026 (according toNEP-2020)	
Document code	Syllabus ES-2026
Name of faculty	Science
Faculty code	SCI
Programme name	M. Sc. Environmental Science
Programme code	SCIPGES108
Effective from	June-2026

The proposed new structure for M. Sc. Course (2 years) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMME OBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Environmental Science as an applied science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in an Environmental Science with different specializations.
3. To facilitate higher education & research in Environmental Science.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in Environmental management and Environmental Consultancy.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. Develop a deep, multidisciplinary understanding of ecological systems, earth processes, atmospheric sciences, and the intricate interactions between human activities and the natural environment.
2. Master advanced quantitative and qualitative tools for environmental analysis, including laboratory techniques for testing water, soil, and air quality, as well as field sampling methodologies.
3. Gain expertise in modern environmental technologies and digital tools, such as Geographic Information Systems (GIS), Remote Sensing, and environmental modeling software to map and analyze ecological data.
4. Acquire the skills to design, conduct, and evaluate Environmental Impact Assessments (EIA), Environmental Audits, and risk management strategies in compliance with industrial and governmental standards.
5. Understand national and international environmental laws, policies, and treaties (such as those regarding climate change and biodiversity), enabling the integration of sustainability principles into corporate and public governance.
6. Apply critical thinking to design innovative, sustainable solutions for pressing ecological challenges, including waste management, pollution control, renewable energy adoption, and habitat restoration.
7. Formulate research hypotheses, design scientific experiments, analyze complex datasets using statistical tools, and interpret findings to contribute to the evolving field of environmental science.
8. Understand the science of climate change, vulnerability assessment, and global warming mitigation, preparing to lead adaptation strategies for ecosystems, communities, and economies.

M.Sc. Semester I (Environmental Science)

M.Sc. with course work								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSCCES101	Basics of Environmental Science	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCCES102	Current Issues in Environmental Science	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCCES103	Environmental Pollution	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSCCES104	Practical (Basics of Environmental Science, Current Issues in Environmental Science and Environmental Pollution)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MDCES105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course Practical Paper	SC2M26PMDCES106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VACES107	Wildlife and Conservation Biology - 1	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

(with course work)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE
SEMESTER I

PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES101

BASICS OF ENVIRONMENTAL SCIENCE
EFFECTIVE FROM JUNE 2026-27 UNDER

NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objectives:

1. To explain the fundamental structure of the Earth, its climatic zones, and the interactive dynamics of global biomes and the biosphere.
2. To analyze atmospheric composition, chemistry, energy budgets, and the meteorological processes that dictate weather, climate, and stability.
3. To investigate the physical and chemical properties of freshwater and seawater systems, including the distribution of marine mineral resources.
4. To evaluate the composition of the lithosphere, processes of rock weathering, soil formation profiles, and methods for soil conservation.
5. To foster a comprehensive scientific understanding of how the Earth's spheres interact and the current environmental challenges they face.

Course Outcome: Having completed this course, the learner will be able to

1. Explain the structural components of the Earth, the biosphere, and global biomes.
2. Analyze atmospheric chemistry, weather dynamics, and the Earth's energy budget.
3. Describe the chemical properties and environmental significance of fresh and marine water systems.
4. Understand lithospheric properties, soil profile formation, and characteristics.
5. Assess current environmental challenges and strategies for soil and resource conservation.

Sr. No		Credit	Hr.

1	**Unit-1**	**Understanding our Earth** • Understanding our Earth and its Environment • Structure of Earth, Concept of Biosphere and biomes • Earth's climatic zones • Principle components of environment, their interaction and significance • Definition, Principles and Scope of Environmental Science	**1**	**15**
2	**Unit-2**	**Atmosphere** • Composition, structure and functions of atmosphere • Dynamicity in Climate, Weather and other atmospheric processes • Atmospheric chemistry, classification of elements, • Earth's energy budget, reactions in the lower and upper atmosphere, atmospheric stability, inversions and mixing heights, wind roses • Precipitation: Rain, snow, dew, mist and fog • Earth's current atmosphere and challenges	**1**	**15**
3	**Unit-3**	**Hydrosphere** • Structure and properties of water and their environmental significance • Distribution of water in earth, fresh water and its chemistry, Solubility of gases in water, role of water in environment • Seawater properties and its constituents, nutrients and salts, • Metallic and non-metallic mineral resources like manganese nodules etc.	**1**	**15**
4	**Unit-4**	**Lithosphere** • Structure and Composition of Earth crust • Rock types and formation, sedimentation, weathering • Factors and processes of soil development, • Soil components and their importance. • Soil types and their formation, Soil profiles, • Physical and chemical properties	**1**	**15**
	Suggested References: 1. Environmental Chemistry, 2018. Anil Kumar De. New Age International Publishers 2. Environmental Science, 2017. S C Santra. New Central Book Agency (NCBA) 3. Introduction to Environmental Engineering and Science, 2020, Third Edition by Gilbert M. Masters and Wendell P. Ela, Pearson Publication 4. Introduction to Environmental Sciences, R.S. Khoiyangbam, Navindu Gupta, TERI Press			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M.SC. ENVIRONMENTAL SCIENCE
SEMESTER I
PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES102
CURRENT ISSUES IN ENVIRONMENTAL SCIENCE
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives :

1. To understand major global environmental crises, carbon cycling, and climate change drivers.
2. To study the strategic components and goals of India's National Action Plan on Climate Change (NAPCC).
3. To analyze the environmental impacts of major water resource projects and river restoration programs in India.
4. To introduce concepts of sustainable habitat, green building ratings, and national waste management initiatives.
5. To evaluate the triggers, consequences, and lessons learned from major historical environmental disasters and epidemiological issues.

Course Outcomes :

1. Explain global environmental issues, carbon footprint dynamics, and radioactive risks.
2. Analyze the functioning and targets of the eight missions under India's NAPCC.
3. Evaluate river conservation plans, wetland restoration strategies, and water harvesting methods.
4. Understand the criteria for green buildings, waste management missions, and vehicular emission norms.
5. Identify the causes of key environmental disasters and prominent environmentally-linked diseases.

Sr. No			Credit	Hr.
1	Unit-1	**Global Environmental Issues** • Problems their causes and sustainability, Population growth and environment • Global environment problems: O_3 depletion, Global Warming, Ice-cap melting, Sea-level rise, Shore erosion, Major climatic changes, Storms • Radioactive leakages and environment • Carbon emission, Earth Carbon Reservoirs, Carbon Cycling, Carbon credits, Carbon footprints	1	15

2	**Unit-2**	**Environmental issues in India** • Environmental issues related to • water resource projects - Narmada dam, Tehri dam, Almatti dam, Cauvery • and Mahanadi, Hydro-power projects in Jammu & Kashmir, Himachal and • North-Eastern States.Water conservation-development of watersheds, Rain water harvesting and • ground water recharge.National river conservation plan – Namami Gange and Yamuna Action Plan. • Eutrophication and restoration of lakes. Conservation of wetlands, Ramsar sites in India.	**1**	**15**
3	**Unit-3**	**India's National Action Plan on Environmental Issues-** I • National Action Plan on Climate Change (Eight National missions –National Solar Mission, • National Mission for Enhanced Energy Efficiency, • National Mission on Sustainable Habitat, National Water Mission, National • Mission for Sustaining the Himalayan Ecosystem, • National Mission for a 'Green India', • National Mission for Sustainable Agriculture, • National Mission on Strategic Knowledge for Climate Change).	**1**	**15**
4	**Unit-4**	**India's National Action Plan on Environmental Issues-** I • Waste Management – Swachha Bharat Abhiyan. • Sustainable Habitat: Green Building, • GRIHA Rating Norms. • Vehicular emission norms in India. • Epidemiological Issues: Fluorosis, Arsenocosis, Goitre, Dengue. • Environmental Disasters: Minnamata Disaster, Love Canal Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukusima Daiichi nuclear disaster, 2011.	**1**	**15**
	Suggested Reference 1. Global Warming and Climate Change: Past, Present and Future, 2002. S. K. Agarwal, APH Publishing Corporation 2. Environmental studies: from crisis to cure, 2015. Rajagopalan. Oxford University Press 3. Ecology and Environment, 2015. P. D. Sharma. Rastogi Publications			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRINMENTLAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES103

ENVIRONMENTAL POLLUTION
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives :
1. To define types of pollutants and explain the behavior, dispersion, and measurement of air pollutants.
2. To study municipal and industrial wastewater treatment processes alongside the dynamics of marine pollution.
3. To analyze the sources and impacts of thermal pollution on aquatic ecosystems and water quality.
4. To evaluate the causes of soil degradation and explore sustainable agricultural interventions like IPM, INM, and organic farming.
5. To understand the characteristics, measurement, impacts, and control strategies for both noise and radiation pollution.

Course Outcomes :
1. Explain air pollution mechanics, atmospheric stability parameters, and specific pollutant control techniques.
2. Analyze the stages of wastewater treatment alongside the ecological impacts of marine and coastal pollution.
3. Evaluate the hazardous long-term impacts of thermal discharge on aquatic life and water quality.
4. Propose methods for soil pollution management, land restoration, and sustainable agricultural practices.
5. Apply measurement metrics and national standards to mitigate ambient noise and radioactive risks

Sr. No			Credit	Hr.
1	**Unit-1**	**Environmental Pollutions** • Definitions of Pollution and pollutant, types and origin, classification of pollutants, General concept, classification of pollutants • Air pollution: Composition of air, Major sources, Types and Properties of air pollutants, • behaviour and fate of air pollutants, chlorofluoro carbons and ozone layer depletion, green house gases and concept of global warming, its origin, status and means to control • Temperature lapse rates and stability, wind velocity and turbulence, plume behaviour and dispersion of air pollutants • Sampling and measurement of air pollutants, control methods and equipment	1	15
2	**Unit-2**	**Water pollution** • Introduction, definition of water pollution, types and sources of water pollutants and their effects, • Waste water treatment. • Water treatment (types, methods of waste water treatment: Preliminary, Primary, Secondary and Tertiary: • Removal of suspended and dissolved solids, nitrogen and phosphorous, advanced biological system, chemical oxidation, recovery of materials from process effluents), purification of water • Pollution of Marine Environment: Sources and nature of pollutants, oil pollution, metallic pollutants, status of coastal and estuarine pollution in India, Chemicals and drugs from oceans, sea level rise, cause, effect and control • Thermal pollution: Introduction, Concept of thermal pollution, sources of thermal pollution, thermal power plant pollution, hazardous effects, long-term impact, thermal effects on marine life, effects on water quality, prevention of thermal pollution	1	15
3	**Unit-3**	**Soil pollution** • Introduction, importance of soil, composition of soil, soil pollution by different wastes (industrial wastes, urban wastes, radioactive pollutants, agricultural practices {chemical fertilizers and pesticides}, chemical and metallic pollutants, sewage and domestic waste) • Control of soil pollution, preventive measures, Integrated Pest management, Integrated Nutrient management, introduction of Organic Farming and Biofertilizers, restoration of degraded lands	1	15

4	**Unit-4**	**Noise and Radiation Pollutions** • Introduction, Sources of noise, • characteristics of sound, measurement of noise, • types of noise, effects of noise pollution, • Indian ambient noise level standards, • prevention and control of noise pollution • Radiation Pollution: Introduction, types of radiation and radioactivity, source and effect	**1**	**15**
	Suggested Reference: 1. Environmental Pollution Control Engineering, 2007. C. S. Rao. New Age International. 2. Textbook of Environmental Engineering, 2004. P. Venugopala Rao. PHI. 3. Environmental Chemistry, 2018. Anil Kumar De. New Age International Publishers 4. Environmental Science, 2017. S C Santra. New Central Book Agency (NCBA)			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCES104

BASICS OF ENVIRONMENTAL SCIENCE, CURRENT ISSUES IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL POLLUTION
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. GLP (Good Laboratory Practices)
2. Preparation of Standards and other experimental chemicals and reagents
3. Study of cleaning and sterilization of glass ware
4. Physical characteristic of waste water (Hardness, Colour, turbidity, TDS, SS, DS, Alkainity and Acidity etc.)
5. DO (Dissolve Oxygen),
6. COD (Chemical Oxygen Demand)
7. BOD (Biological Oxygen Demand)
8. Determination of total calcium and Magnesium
9. Determination of total organic carbon from the given sample
10. Determination of total phosphorus from the given sample
11. Determination of total Nitrogen from the given sample
12. Estimation of chloride from the given water sample
13. Determination phosphorus from the given water sample
14. Estimation of Dissolve CO_2 from given samples
15. Air quality monitoring basic
16. Air quality monitoring (SPM, aerosol, etc)
17. Physical properties of soil (moisture, water holding capacity, texture, porosity, bulk density)
18. Industrial field visit for the study of effluent treatment plant
19. Field visit and report preparation

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108

MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26MDCMB105

RESEARCH DESIGN AND DATA ANALYSIS
EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	**2 Period Per Week**	**Theory**	**External 25 Marks** **Internal 25 Marks**

Course Objectives:

1. To introduce the core concepts of biostatistics, data presentation, and the application of both parametric and non-parametric statistical tests.
2. To understand the systematic research process, including formulation, sampling design strategies, and robust methods of data collection.
3. To develop essential skills in scientific communication, journal selection criteria, manuscript preparation, and tracking research impact metrics

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	**Biostatistics** ● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student's t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit.	1	15

2	Unit-2	**Research Methodology** ● Introduction to research methodology, type of research, research method vs methodology. ● Research process, type of sampling design, and methods of data collection. ● Scientific deliveries and communications: writing research proposal, paper, thesis, and report. ● Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. ● Publication processes, review processes and significance of scientific communications	1	15

References:

1. Research Methodology: Methods and Techniques, 2019. C.R. Kothari and Gaurav Garg. New Age International Publishers.
2. How to Write and Publish a Scientific Paper, 2017. Robert A. Day and Barbara Gastel. Cambridge University Press

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCES106

RESEARCH DESIGN AND DATA ANALYSIS EFFECTIVE FROM JUNE 2026-2027

UNDER NEP

Total Credit - 2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student's t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

VALUE ADDED COURSE CODE: SC2M26VACES107

WILDLIFE AND CONSERVATION BIOLOGY - I
EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	(02 Period/Week)	Internal-25 Marks	External-25 Marks	External 25 Marks Internal 25 Marks

Course objective:

1. To define the core concepts and scope of wildlife as a vital global natural resource.
2. To examine the diverse wildlife habitats and ecological zones across the Indian subcontinent.
3. To analyze modern wildlife management techniques, protected area networks, and community-driven conservation practices in India.

Course Outcome: Having completed this course, the learner will be able to:

1. Explain the fundamental definitions, scope, and resource value of global wildlife.
2. Identify and characterize the major wildlife habitats unique to the Indian subcontinent.
3. Evaluate the role of Protected Areas (PAs), community partnerships, and current management practices in India.

Unit	Content	Credit	Hours
I	**Wildlife as Natural resource** • Wildlife: Definition, Scope and wildlife as natural resource • Conservation: Definition, History and Background and types of conservation • Significance of wildlife conservation • Wildlife habitats in Indian subcontinent	01	15
II	**Wildlife Conservation Management** • Wildlife management (History and current advances) • Protected areas and role of PAs in wildlife conservation • Community and conservation • Current wildlife conservation practices in India	01	15

	Suggested reference 1. Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity 2. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M.SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCES104

BASICS OF ENVIRONMENTAL SCIENCE, CURRENT ISSUES IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL POLLUTION

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Do as directed	**10**
Q2		Do as directed	**10**
Q3		Do as directed	**05**
Q4		Do as directed.	**05**
Q5	**a**	Spotting	**10**
	b	Journal	**05**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PMDCES106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: More than 3 Hours **Total Marks: 25**

Q1		Do as directed	**05**
Q2		Do as directed	**05**
Q3		Do as directed	**05**
Q4		Spotting / Do as directed	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN-384265

Faculty of Science

M. Sc. Environmental Science
(2 yrs with course work and Research)

Syllabus/ scheme

Semester – 1 to 4

SEMESTER – I
(with course work and Research)

With effect from

June-2026

Date: 12/06/2026 Total page: 23

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Environmental Science) Syllabus 2026 (according toNEP-2020)	
Document code	Syllabus ES-2026
Name of faculty	Science
Faculty code	SCI
Programme name	M. Sc. Environmental Science
Programme code	SCIPGES108
Effective from	June-2026

The proposed new structure for M. Sc. Course (2 years with coursework and Research) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMME OBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Environmental Science as an applied science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in an Environmental Science with different specializations.
3. To facilitate higher education & research in Environmental Science.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in Environmental management and Environmental Consultancy.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. Develop a deep, multidisciplinary understanding of ecological systems, earth processes, atmospheric sciences, and the intricate interactions between human activities and the natural environment.
2. Master advanced quantitative and qualitative tools for environmental analysis, including laboratory techniques for testing water, soil, and air quality, as well as field sampling methodologies.
3. Gain expertise in modern environmental technologies and digital tools, such as Geographic Information Systems (GIS), Remote Sensing, and environmental modeling software to map and analyze ecological data.
4. Acquire the skills to design, conduct, and evaluate Environmental Impact Assessments (EIA), Environmental Audits, and risk management strategies in compliance with industrial and governmental standards.
5. Understand national and international environmental laws, policies, and treaties (such as those regarding climate change and biodiversity), enabling the integration of sustainability principles into corporate and public governance.
6. Apply critical thinking to design innovative, sustainable solutions for pressing ecological challenges, including waste management, pollution control, renewable energy adoption, and habitat restoration.
7. Formulate research hypotheses, design scientific experiments, analyze complex datasets using statistical tools, and interpret findings to contribute to the evolving field of environmental science.
8. Understand the science of climate change, vulnerability assessment, and global warming mitigation, preparing to lead adaptation strategies for ecosystems, communities, and economies.

M.Sc. Semester I (Environmental Science)

M.Sc. course work with research								
Course	**Course code**	**Paper title**	**Teaching hours per week**	**CCE**	**SEE**	**Total marks**	**Credit points**	**Exam duration (Hours)**
Discipline Specific core course	SC2M26DSCCES101	Basics of Environmental Science	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCCES102	Current Issues in Environmental Science	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCCES103	Environmental Pollution	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSCCES104	Practical (Basics of Environmental Science, Current Issues in Environmental Science and Environmental Pollution)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MDCES105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course Practical Paper	SC2M26PMDCES106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VACES107	Wildlife and Conservation Biology - 1	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

(with course work and Research)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE
SEMESTER I

PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES101

BASICS OF ENVIRONMENTAL SCIENCE
EFFECTIVE FROM JUNE 2026-27 UNDER

NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives:

1. To explain the fundamental structure of the Earth, its climatic zones, and the interactive dynamics of global biomes and the biosphere.
2. To analyze atmospheric composition, chemistry, energy budgets, and the meteorological processes that dictate weather, climate, and stability.
3. To investigate the physical and chemical properties of freshwater and seawater systems, including the distribution of marine mineral resources.
4. To evaluate the composition of the lithosphere, processes of rock weathering, soil formation profiles, and methods for soil conservation.
5. To foster a comprehensive scientific understanding of how the Earth's spheres interact and the current environmental challenges they face.

Course Outcome: Having completed this course, the learner will be able to

1. Explain the structural components of the Earth, the biosphere, and global biomes.
2. Analyze atmospheric chemistry, weather dynamics, and the Earth's energy budget.
3. Describe the chemical properties and environmental significance of fresh and marine water systems.
4. Understand lithospheric properties, soil profile formation, and characteristics.
5. Assess current environmental challenges and strategies for soil and resource conservation.

Sr. No		**Credit**	**Hr.**

1	Unit-1	**Understanding our Earth** • Understanding our Earth and its Environment • Structure of Earth, Concept of Biosphere and biomes • Earth's climatic zones • Principle components of environment, their interaction and significance • Definition, Principles and Scope of Environmental Science	1	15
2	Unit-2	**Atmosphere** • Composition, structure and functions of atmosphere • Dynamicity in Climate, Weather and other atmospheric processes • Atmospheric chemistry, classification of elements, • Earth's energy budget, reactions in the lower and upper atmosphere, atmospheric stability, inversions and mixing heights, wind roses • Precipitation: Rain, snow, dew, mist and fog • Earth's current atmosphere and challenges	1	15
3	Unit-3	**Hydrosphere** • Structure and properties of water and their environmental significance • Distribution of water in earth, fresh water and its chemistry, Solubility of gases in water, role of water in environment • Seawater properties and its constituents, nutrients and salts, • Metallic and non-metallic mineral resources like manganese nodules etc.	1	15
4	Unit-4	**Lithosphere** • Structure and Composition of Earth crust • Rock types and formation, sedimentation, weathering • Factors and processes of soil development, • Soil components and their importance. • Soil types and their formation, Soil profiles, • Physical and chemical properties	1	15
	Suggested References: 1. Environmental Chemistry, 2018. Anil Kumar De. New Age International Publishers 2. Environmental Science, 2017. S C Santra. New Central Book Agency (NCBA) 3. Introduction to Environmental Engineering and Science, 2020, Third Edition by Gilbert M. Masters and Wendell P. Ela, Pearson Publication 4. Introduction to Environmental Sciences, R.S. Khoiyangbam, Navindu Gupta, TERI Press			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M.SC. ENVIRONMENTAL SCIENCE
SEMESTER I
PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES102
CURRENT ISSUES IN ENVIRONMENTAL SCIENCE
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objectives :

1. To understand major global environmental crises, carbon cycling, and climate change drivers.
2. To study the strategic components and goals of India's National Action Plan on Climate Change (NAPCC).
3. To analyze the environmental impacts of major water resource projects and river restoration programs in India.
4. To introduce concepts of sustainable habitat, green building ratings, and national waste management initiatives.
5. To evaluate the triggers, consequences, and lessons learned from major historical environmental disasters and epidemiological issues.

Course Outcomes :

1. Explain global environmental issues, carbon footprint dynamics, and radioactive risks.
2. Analyze the functioning and targets of the eight missions under India's NAPCC.
3. Evaluate river conservation plans, wetland restoration strategies, and water harvesting methods.
4. Understand the criteria for green buildings, waste management missions, and vehicular emission norms.
5. Identify the causes of key environmental disasters and prominent environmentally-linked diseases.

Sr. No			Credit	Hr.
1	Unit-1	**Global Environmental Issues** • Problems their causes and sustainability, Population growth and environment • Global environment problems: O_3 depletion, Global Warming, Ice-cap melting, Sea-level rise, Shore erosion, Major climatic changes, Storms • Radioactive leakages and environment • Carbon emission, Earth Carbon Reservoirs, Carbon Cycling, Carbon credits, Carbon footprints	1	15

2	**Unit-2**	**Environmental issues in India** • Environmental issues related to • water resource projects - Narmada dam, Tehri dam, Almatti dam, Cauvery • and Mahanadi, Hydro-power projects in Jammu & Kashmir, Himachal and • North-Eastern States. Water conservation-development of watersheds, Rain water harvesting and • ground water recharge. National river conservation plan – Namami Gange and Yamuna Action Plan. • Eutrophication and restoration of lakes. Conservation of wetlands, Ramsar sites in India.	**1**	**15**
3	**Unit-3**	**India's National Action Plan on Environmental Issues-** I • National Action Plan on Climate Change (Eight National missions –National Solar Mission, • National Mission for Enhanced Energy Efficiency, • National Mission on Sustainable Habitat, National Water Mission, National • Mission for Sustaining the Himalayan Ecosystem, • National Mission for a 'Green India', • National Mission for Sustainable Agriculture, • National Mission on Strategic Knowledge for Climate Change).	**1**	**15**
4	**Unit-4**	**India's National Action Plan on Environmental Issues-** I • Waste Management – Swachha Bharat Abhiyan. • Sustainable Habitat: Green Building, • GRIHA Rating Norms. • Vehicular emission norms in India. • Epidemiological Issues: Fluorosis, Arsenocosis, Goitre, Dengue. • Environmental Disasters: Minnamata Disaster, Love Canal Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukusima Daiichi nuclear disaster, 2011.	**1**	**15**
	Suggested Reference 1. Global Warming and Climate Change: Past, Present and Future, 2002. S. K. Agarwal, APH Publishing Corporation 2. Environmental studies: from crisis to cure, 2015. Rajagopalan. Oxford University Press 3. Ecology and Environment, 2015. P. D. Sharma. Rastogi Publications			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRINMENTLAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES103

ENVIRONMENTAL POLLUTION
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objectives :

1. To define types of pollutants and explain the behavior, dispersion, and measurement of air pollutants.
2. To study municipal and industrial wastewater treatment processes alongside the dynamics of marine pollution.
3. To analyze the sources and impacts of thermal pollution on aquatic ecosystems and water quality.
4. To evaluate the causes of soil degradation and explore sustainable agricultural interventions like IPM, INM, and organic farming.
5. To understand the characteristics, measurement, impacts, and control strategies for both noise and radiation pollution.

Course Outcomes :

1. Explain air pollution mechanics, atmospheric stability parameters, and specific pollutant control techniques.
2. Analyze the stages of wastewater treatment alongside the ecological impacts of marine and coastal pollution.
3. Evaluate the hazardous long-term impacts of thermal discharge on aquatic life and water quality.
4. Propose methods for soil pollution management, land restoration, and sustainable agricultural practices.
5. Apply measurement metrics and national standards to mitigate ambient noise and radioactive risks

Sr. No			Credit	Hr.
1	Unit-1	**Environmental Pollutions** • Definitions of Pollution and pollutant, types and origin, classification of pollutants, General concept, classification of pollutants • Air pollution: Composition of air, Major sources, Types and Properties of air pollutants, • behaviour and fate of air pollutants, chlorofluoro carbons and ozone layer depletion, green house gases and concept of global warming, its origin, status and means to control • Temperature lapse rates and stability, wind velocity and turbulence, plume behaviour and dispersion of air pollutants • Sampling and measurement of air pollutants, control methods and equipment	1	15
2	Unit-2	**Water pollution** • Introduction, definition of water pollution, types and sources of water pollutants and their effects, • Waste water treatment. • Water treatment (types, methods of waste water treatment: Preliminary, Primary, Secondary and Tertiary: • Removal of suspended and dissolved solids, nitrogen and phosphorous, advanced biological system, chemical oxidation, recovery of materials from process effluents), purification of water • Pollution of Marine Environment: Sources and nature of pollutants, oil pollution, metallic pollutants, status of coastal and estuarine pollution in India, Chemicals and drugs from oceans, sea level rise, cause, effect and control • Thermal pollution: Introduction, Concept of thermal pollution, sources of thermal pollution, thermal power plant pollution, hazardous effects, long-term impact, thermal effects on marine life, effects on water quality, prevention of thermal pollution	1	15
3	Unit-3	**Soil pollution** • Introduction, importance of soil, composition of soil, soil pollution by different wastes (industrial wastes, urban wastes, radioactive pollutants, agricultural practices {chemical fertilizers and pesticides}, chemical and metallic pollutants, sewage and domestic waste) • Control of soil pollution, preventive measures, Integrated Pest management, Integrated Nutrient management, introduction of Organic Farming and Biofertilizers, restoration of degraded lands	1	15

4	**Unit-4**	**Noise and Radiation Pollutions** • Introduction, Sources of noise, • characteristics of sound, measurement of noise, • types of noise, effects of noise pollution, • Indian ambient noise level standards, • prevention and control of noise pollution • Radiation Pollution: Introduction, types of radiation and radioactivity, source and effect	**1**	**15**
	Suggested Reference: 1. Environmental Pollution Control Engineering, 2007. C. S. Rao. New Age International. 2. Textbook of Environmental Engineering, 2004. P. Venugopala Rao. PHI. 3. Environmental Chemistry, 2018. Anil Kumar De. New Age International Publishers 4. Environmental Science, 2017. S C Santra. New Central Book Agency (NCBA)			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCES104

BASICS OF ENVIRONMENTAL SCIENCE, CURRENT ISSUES IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL POLLUTION
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. GLP (Good Laboratory Practices)
2. Preparation of Standards and other experimental chemicals and reagents
3. Study of cleaning and sterilization of glass ware
4. Physical characteristic of waste water (Hardness, Colour, turbidity, TDS, SS, DS, Alkainity and Acidity etc.)
5. DO (Dissolve Oxygen),
6. COD (Chemical Oxygen Demand)
7. BOD (Biological Oxygen Demand)
8. Determination of total calcium and Magnesium
9. Determination of total organic carbon from the given sample
10. Determination of total phosphorus from the given sample
11. Determination of total Nitrogen from the given sample
12. Estimation of chloride from the given water sample
13. Determination phosphorus from the given water sample
14. Estimation of Dissolve CO_2 from given samples
15. Air quality monitoring basic
16. Air quality monitoring (SPM, aerosol, etc)
17. Physical properties of soil (moisture, water holding capacity, texture, porosity, bulk density)
18. Industrial field visit for the study of effluent treatment plant
19. Field visit and report preparation

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26MDCMB105

RESEARCH DESIGN AND DATA ANALYSIS
EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Course Objectives:

1. To introduce the core concepts of biostatistics, data presentation, and the application of both parametric and non-parametric statistical tests.
2. To understand the systematic research process, including formulation, sampling design strategies, and robust methods of data collection.
3. To develop essential skills in scientific communication, journal selection criteria, manuscript preparation, and tracking research impact metrics

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	**Biostatistics** ● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student’s t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit.	1	15

2	Unit-2	**Research Methodology** ● Introduction to research methodology, type of research, research method vs methodology. ● Research process, type of sampling design, and methods of data collection. ● Scientific deliveries and communications: writing research proposal, paper, thesis, and report. ● Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. ● Publication processes, review processes and significance of scientific communications.	1	15

References:

1. Research Methodology: Methods and Techniques, 2019. C.R. Kothari and Gaurav Garg. New Age International Publishers.
2. How to Write and Publish a Scientific Paper, 2017. Robert A. Day and Barbara Gastel. Cambridge University Press

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCES106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
    a. Arithmetic Mean
    b. Harmonic Mean
    c. Geometric Mean
    d. Median
    e. Mode
2. Computation of various measures of dispersion:
    a. Standard Deviation
    b. Standard error
3. To perform Student's t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
    a. Sign test
    b. Wilcoxon signed-rank test
    c. Kruskal-Wallis test
    d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

VALUE ADDED COURSE CODE: SC2M26VACES107

WILDLIFE AND CONSERVATION BIOLOGY - I
EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	(02 Period/Week)	Internal-25 Marks	External-25 Marks	External 25 Marks Internal 25 Marks

Course objective:
1. To define the core concepts and scope of wildlife as a vital global natural resource.
2. To examine the diverse wildlife habitats and ecological zones across the Indian subcontinent.
3. To analyze modern wildlife management techniques, protected area networks, and community-driven conservation practices in India.

Course Outcome: Having completed this course, the learner will be able to:
1. Explain the fundamental definitions, scope, and resource value of global wildlife.
2. Identify and characterize the major wildlife habitats unique to the Indian subcontinent.
3. Evaluate the role of Protected Areas (PAs), community partnerships, and current management practices in India.

Unit	Content	Credit	Hours
I	**Wildlife as Natural resource** • Wildlife: Definition, Scope and wildlife as natural resource • Conservation: Definition, History and Background and types of conservation • Significance of wildlife conservation • Wildlife habitats in Indian subcontinent	**01**	**15**
II	**Wildlife Conservation Management** • Wildlife management (History and current advances) • Protected areas and role of PAs in wildlife conservation • Community and conservation • Current wildlife conservation practices in India	**01**	**15**

	Suggested reference 1. Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity 2. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M.SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCES104

BASICS OF ENVIRONMENTAL SCIENCE, CURRENT ISSUES IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL POLLUTION

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Do as directed	**10**
Q2		Do as directed	**10**
Q3		Do as directed	**05**
Q4		Do as directed.	**05**
Q5	**a**	Spotting	**10**
	b	Journal	**05**
	c	Viva-voce	**05**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN
COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PMDCES106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Do as directed	**05**
Q2		Do as directed	**05**
Q3		Do as directed	**05**
Q4		Spotting / Do as directed	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC B (2.21) State University PATAN-384265

Faculty of Science

M. Sc. Environmental Science
(2 yrs with Research)

Syllabus/ scheme

Semester – 1 to 4

SEMESTER – I
(with Research)

With effect from

June-2026

Date: 12/06/2026 Total page: 24

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
M. Sc. (Environmental Science) Syllabus 2026 (according toNEP-2020)	
Document code	**Syllabus ES-2026**
Name of faculty	**Science**
Faculty code	**SCI**
Programme name	**M. Sc. Environmental Science**
Programme code	**SCIPGES108**
Effective from	**June-2026**

The proposed new structure for M. Sc. Course (2 years) is based on NEP-2020 which is in force June- 2026.

Course Pattern

1. This programme is divided into **Four Semesters** (Two Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 88 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be English.

Language of question paper: Question paper should be drawn in English.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skills (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each).
Q.4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each).
Q.5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each).
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q.1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each).
Q.2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each).
Q.3	05	08 short questions must be drawn from both units; out of which any 05 must be answered (1 marks each).
Total	**25**	

PROGRAMME OBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Environmental Science as an applied science and its applied branches to the students. The Department has the following objectives:
2. To provide quality education in an Environmental Science with different specializations.
3. To facilitate higher education & research in Environmental Science.
4. To provide quality education, offering skill-based programs and motivate the students for self-employment in Environmental management and Environmental Consultancy.
5. To Inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies/Industrial visits and different projects of local and global interests.
7. To provide opportunities for professional and personal development through curricular and co-curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. Develop a deep, multidisciplinary understanding of ecological systems, earth processes, atmospheric sciences, and the intricate interactions between human activities and the natural environment.
2. Master advanced quantitative and qualitative tools for environmental analysis, including laboratory techniques for testing water, soil, and air quality, as well as field sampling methodologies.
3. Gain expertise in modern environmental technologies and digital tools, such as Geographic Information Systems (GIS), Remote Sensing, and environmental modeling software to map and analyze ecological data.
4. Acquire the skills to design, conduct, and evaluate Environmental Impact Assessments (EIA), Environmental Audits, and risk management strategies in compliance with industrial and governmental standards.
5. Understand national and international environmental laws, policies, and treaties (such as those regarding climate change and biodiversity), enabling the integration of sustainability principles into corporate and public governance.
6. Apply critical thinking to design innovative, sustainable solutions for pressing ecological challenges, including waste management, pollution control, renewable energy adoption, and habitat restoration.
7. Formulate research hypotheses, design scientific experiments, analyze complex datasets using statistical tools, and interpret findings to contribute to the evolving field of environmental science.
8. Understand the science of climate change, vulnerability assessment, and global warming mitigation, preparing to lead adaptation strategies for ecosystems, communities, and economies.

M.Sc. Semester I (Environmental Science)

M.Sc. course work with research

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Discipline Specific core course	SC2M26DSCCES101	Basics of Environmental Science	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCCES102	Current Issues in Environmental Science	4	50	50	100	4	2.30
Discipline Specific core course	SC2M26DSCCES103	Environmental Pollution	4	50	50	100	4	2.30
Discipline Specific core course Practical Paper	SC2M26PDSCCES104	Practical (Basics of Environmental Science, Current Issues in Environmental Science and Environmental Pollution)	8	50	50	100	4	6
Multi-Disciplinary Specific core course	SC2M26MDCES105	Research Design and Data Analysis	2	25	25	50	2	2
Multi-Disciplinary Specific core course Practical Paper	SC2M26PMDCES106	Research Design and Data Analysis	4	25	25	50	2	3
Value Added Course	SC2M26VACES107	Wildlife and Conservation Biology - 1	2	25	25	50	2	2
Total			**28**	**275**	**275**	**550**	**22**	

Semester I

(with Research)

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE
SEMESTER I

PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES101

BASICS OF ENVIRONMENTAL SCIENCE
EFFECTIVE FROM JUNE 2026-27 UNDER

NEP

Total Credits- 04 (04 Period/Week)	Theory	External-50 Marks
		Internal- 50 Marks

Course Objectives:

1. To explain the fundamental structure of the Earth, its climatic zones, and the interactive dynamics of global biomes and the biosphere.
2. To analyze atmospheric composition, chemistry, energy budgets, and the meteorological processes that dictate weather, climate, and stability.
3. To investigate the physical and chemical properties of freshwater and seawater systems, including the distribution of marine mineral resources.
4. To evaluate the composition of the lithosphere, processes of rock weathering, soil formation profiles, and methods for soil conservation.
5. To foster a comprehensive scientific understanding of how the Earth's spheres interact and the current environmental challenges they face.

Course Outcome: Having completed this course, the learner will be able to

1. Explain the structural components of the Earth, the biosphere, and global biomes.
2. Analyze atmospheric chemistry, weather dynamics, and the Earth's energy budget.
3. Describe the chemical properties and environmental significance of fresh and marine water systems.
4. Understand lithospheric properties, soil profile formation, and characteristics.
5. Assess current environmental challenges and strategies for soil and resource conservation.

Sr. No		Credit	Hr.

1	**Unit-1**	**Understanding our Earth** • Understanding our Earth and its Environment • Structure of Earth, Concept of Biosphere and biomes • Earth's climatic zones • Principle components of environment, their interaction and significance • Definition, Principles and Scope of Environmental Science	**1**	**15**
2	**Unit-2**	**Atmosphere** • Composition, structure and functions of atmosphere • Dynamicity in Climate, Weather and other atmospheric processes • Atmospheric chemistry, classification of elements, • Earth's energy budget, reactions in the lower and upper atmosphere, atmospheric stability, inversions and mixing heights, wind roses • Precipitation: Rain, snow, dew, mist and fog • Earth's current atmosphere and challenges	**1**	**15**
3	**Unit-3**	**Hydrosphere** • Structure and properties of water and their environmental significance • Distribution of water in earth, fresh water and its chemistry, Solubility of gases in water, role of water in environment • Seawater properties and its constituents, nutrients and salts, • Metallic and non-metallic mineral resources like manganese nodules etc.	**1**	**15**
4	**Unit-4**	**Lithosphere** • Structure and Composition of Earth crust • Rock types and formation, sedimentation, weathering • Factors and processes of soil development, • Soil components and their importance. • Soil types and their formation, Soil profiles, • Physical and chemical properties	**1**	**15**
	Suggested References: 1. Environmental Chemistry, 2018. Anil Kumar De. New Age International Publishers 2. Environmental Science, 2017. S C Santra. New Central Book Agency (NCBA) 3. Introduction to Environmental Engineering and Science, 2020, Third Edition by Gilbert M. Masters and Wendell P. Ela, Pearson Publication 4. Introduction to Environmental Sciences, R.S. Khoiyangbam, Navindu Gupta, TERI Press			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M.SC. ENVIRONMENTAL SCIENCE
SEMESTER I
PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES102

CURRENT ISSUES IN ENVIRONMENTAL SCIENCE

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives :

1. To understand major global environmental crises, carbon cycling, and climate change drivers.
2. To study the strategic components and goals of India's National Action Plan on Climate Change (NAPCC).
3. To analyze the environmental impacts of major water resource projects and river restoration programs in India.
4. To introduce concepts of sustainable habitat, green building ratings, and national waste management initiatives.
5. To evaluate the triggers, consequences, and lessons learned from major historical environmental disasters and epidemiological issues.

Course Outcomes :

1. Explain global environmental issues, carbon footprint dynamics, and radioactive risks.
2. Analyze the functioning and targets of the eight missions under India's NAPCC.
3. Evaluate river conservation plans, wetland restoration strategies, and water harvesting methods.
4. Understand the criteria for green buildings, waste management missions, and vehicular emission norms.
5. Identify the causes of key environmental disasters and prominent environmentally-linked diseases.

Sr. No			Credit	Hr.
1	Unit-1	**Global Environmental Issues** • Problems their causes and sustainability, Population growth and environment • Global environment problems: O_3 depletion, Global Warming, Ice-cap melting, Sea-level rise, Shore erosion, Major climatic changes, Storms • Radioactive leakages and environment • Carbon emission, Earth Carbon Reservoirs, Carbon Cycling, Carbon credits, Carbon footprints	1	15

2	**Unit-2**	**Environmental issues in India** • Environmental issues related to • water resource projects - Narmada dam, Tehri dam, Almatti dam, Cauvery • and Mahanadi, Hydro-power projects in Jammu & Kashmir, Himachal and • North-Eastern States.Water conservation-development of watersheds, Rain water harvesting and • ground water recharge.National river conservation plan – Namami Gange and Yamuna Action Plan. • Eutrophication and restoration of lakes. Conservation of wetlands, Ramsar sites in India.	**1**	**15**
3	**Unit-3**	**India's National Action Plan on Environmental Issues-** I • National Action Plan on Climate Change (Eight National missions –National Solar Mission, • National Mission for Enhanced Energy Efficiency, • National Mission on Sustainable Habitat, National Water Mission, National • Mission for Sustaining the Himalayan Ecosystem, • National Mission for a 'Green India', • National Mission for Sustainable Agriculture, • National Mission on Strategic Knowledge for Climate Change).	**1**	**15**
4	**Unit-4**	**India's National Action Plan on Environmental Issues-** I • Waste Management – Swachha Bharat Abhiyan. • Sustainable Habitat: Green Building, • GRIHA Rating Norms. • Vehicular emission norms in India. • Epidemiological Issues: Fluorosis, Arsenocosis, Goitre, Dengue. • Environmental Disasters: Minnamata Disaster, Love Canal Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukusima Daiichi nuclear disaster, 2011.	**1**	**15**
	Suggested Reference 1. Global Warming and Climate Change: Past, Present and Future, 2002. S. K. Agarwal, APH Publishing Corporation 2. Environmental studies: from crisis to cure, 2015. Rajagopalan. Oxford University Press 3. Ecology and Environment, 2015. P. D. Sharma. Rastogi Publications			

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRINMENTLAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26DSCCES103

ENVIRONMENTAL POLLUTION
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits- 04 (04 Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

Course Objectives :

1. To define types of pollutants and explain the behavior, dispersion, and measurement of air pollutants.
2. To study municipal and industrial wastewater treatment processes alongside the dynamics of marine pollution.
3. To analyze the sources and impacts of thermal pollution on aquatic ecosystems and water quality.
4. To evaluate the causes of soil degradation and explore sustainable agricultural interventions like IPM, INM, and organic farming.
5. To understand the characteristics, measurement, impacts, and control strategies for both noise and radiation pollution.

Course Outcomes :

1. Explain air pollution mechanics, atmospheric stability parameters, and specific pollutant control techniques.
2. Analyze the stages of wastewater treatment alongside the ecological impacts of marine and coastal pollution.
3. Evaluate the hazardous long-term impacts of thermal discharge on aquatic life and water quality.
4. Propose methods for soil pollution management, land restoration, and sustainable agricultural practices.
5. Apply measurement metrics and national standards to mitigate ambient noise and radioactive risks

Sr. No			Credit	Hr.
1	**Unit-1**	**Environmental Pollutions** • Definitions of Pollution and pollutant, types and origin, classification of pollutants, General concept, classification of pollutants • Air pollution: Composition of air, Major sources, Types and Properties of air pollutants, • behaviour and fate of air pollutants, chlorofluoro carbons and ozone layer depletion, green house gases and concept of global warming, its origin, status and means to control • Temperature lapse rates and stability, wind velocity and turbulence, plume behaviour and dispersion of air pollutants • Sampling and measurement of air pollutants, control methods and equipment	1	15
2	**Unit-2**	**Water pollution** • Introduction, definition of water pollution, types and sources of water pollutants and their effects, • Waste water treatment. • Water treatment (types, methods of waste water treatment: Preliminary, Primary, Secondary and Tertiary: • Removal of suspended and dissolved solids, nitrogen and phosphorous, advanced biological system, chemical oxidation, recovery of materials from process effluents), purification of water • Pollution of Marine Environment: Sources and nature of pollutants, oil pollution, metallic pollutants, status of coastal and estuarine pollution in India, Chemicals and drugs from oceans, sea level rise, cause, effect and control • Thermal pollution: Introduction, Concept of thermal pollution, sources of thermal pollution, thermal power plant pollution, hazardous effects, long-term impact, thermal effects on marine life, effects on water quality, prevention of thermal pollution	1	15
3	**Unit-3**	**Soil pollution** • Introduction, importance of soil, composition of soil, soil pollution by different wastes (industrial wastes, urban wastes, radioactive pollutants, agricultural practices {chemical fertilizers and pesticides}, chemical and metallic pollutants, sewage and domestic waste) • Control of soil pollution, preventive measures, Integrated Pest management, Integrated Nutrient management, introduction of Organic Farming and Biofertilizers, restoration of degraded lands	1	15

<table>
<tr><td>4</td><td>Unit-4</td><td>Noise and Radiation Pollutions
• Introduction, Sources of noise,
• characteristics of sound, measurement of noise,
• types of noise, effects of noise pollution,
• Indian ambient noise level standards,
• prevention and control of noise pollution
• Radiation Pollution: Introduction, types of radiation and radioactivity, source and effect</td><td>1</td><td>15</td></tr>
<tr><td></td><td colspan="3">Suggested Reference:
1. Environmental Pollution Control Engineering, 2007. C. S. Rao. New Age International.
2. Textbook of Environmental Engineering, 2004. P. Venugopala Rao. PHI.
3. Environmental Chemistry, 2018. Anil Kumar De. New Age International Publishers
4. Environmental Science, 2017. S C Santra. New Central Book Agency (NCBA)</td><td></td></tr>
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HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCES104

BASICS OF ENVIRONMENTAL SCIENCE, CURRENT ISSUES IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL POLLUTION
EFFECTIVE FROM JUNE 2026-27 UNDER NEP

Total Credits: 04	(08 Period/Week)	Internal Marks: 50	External Marks: 50	Total Marks: 100

List of Practicals

1. GLP (Good Laboratory Practices)
2. Preparation of Standards and other experimental chemicals and reagents
3. Study of cleaning and sterilization of glass ware
4. Physical characteristic of waste water (Hardness, Colour, turbidity, TDS, SS, DS, Alkainity and Acidity etc.)
5. DO (Dissolve Oxygen),
6. COD (Chemical Oxygen Demand)
7. BOD (Biological Oxygen Demand)
8. Determination of total calcium and Magnesium
9. Determination of total organic carbon from the given sample
10. Determination of total phosphorus from the given sample
11. Determination of total Nitrogen from the given sample
12. Estimation of chloride from the given water sample
13. Determination phosphorus from the given water sample
14. Estimation of Dissolve CO_2 from given samples
15. Air quality monitoring basic
16. Air quality monitoring (SPM, aerosol, etc)
17. Physical properties of soil (moisture, water holding capacity, texture, porosity, bulk density)
18. Industrial field visit for the study of effluent treatment plant
19. Field visit and report preparation

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26MDCMB105

RESEARCH DESIGN AND DATA ANALYSIS
EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Theory	External 25 Marks Internal 25 Marks

Course Objectives:

1. To introduce the core concepts of biostatistics, data presentation, and the application of both parametric and non-parametric statistical tests.
2. To understand the systematic research process, including formulation, sampling design strategies, and robust methods of data collection.
3. To develop essential skills in scientific communication, journal selection criteria, manuscript preparation, and tracking research impact metrics

Course Outcome:

After thorough understanding of the content student will be able to explain:

1. Understand basic statistics, statistical significance, relationships between variables, and the use of parametric, and non-parametric tests.
2. Understand research methodology, including data collection, sampling design, and the importance of scientific publication and presentation.

Sr. No			Credit	Hr.
1	Unit-1	**Biostatistics** ● Definition and scope of biostatistics, different types of graphs. ● Measures of central tendency, standard deviation, and standard error. ● Statistical significance: hypothesis testing, types of error, level of significance. ● Parametric test: student’s t test, Anova, simple linear regression and correlation analysis. ● Non-parametric test: Sign test, Wilcoxon signed-rank test, Mann –Whitney (U) test, Kruskal-Wallis test, and Chi square goodness of fit.	1	15

2	**Unit-2**	**Research Methodology** ● Introduction to research methodology, type of research, research method vs methodology. ● Research process, type of sampling design, and methods of data collection. ● Scientific deliveries and communications: writing research proposal, paper, thesis, and report. ● Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications. ● Publication processes, review processes and significance of scientific communications	**1**	**15**

References:

1. Research Methodology: Methods and Techniques, 2019. C.R. Kothari and Gaurav Garg. New Age International Publishers.
2. How to Write and Publish a Scientific Paper, 2017. Robert A. Day and Barbara Gastel. Cambridge University Press

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I

PROGRAM CODE: SCIPGES108
PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE:

SC2M26PMDCES106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credit - 2	2 Period Per Week	Practical	External 25 Marks Internal 25 Marks

List of Practicals

1. Computation of different measures of central tendency:
   a. Arithmetic Mean
   b. Harmonic Mean
   c. Geometric Mean
   d. Median
   e. Mode
2. Computation of various measures of dispersion:
   a. Standard Deviation
   b. Standard error
3. To perform Student's t test and single factor Analysis of Variance (ANOVA).
4. To study and perform regression analysis and prediction of future events.
5. To study and perform correlation analysis.
6. To perform Chi Square test of goodness of fit.
7. To perform different non-parametric tests:
   a. Sign test
   b. Wilcoxon signed-rank test
   c. Kruskal-Wallis test
   d. Mann –Whitney (U) test
8. To perform formatting of references using different referencing style.
9. Scientific writing practice (Research proposal).
10. Study of reference management system (MyBib, Zotero, Mendeley).

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COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

VALUE ADDED COURSE CODE: SC2M26VACES107

WILDLIFE AND CONSERVATION BIOLOGY - I
EFFECTIVE FROM JUNE 2026-2027 UNDER NEP

Total Credits-02	(02 Period/Week)	Internal-25 Marks	External-25 Marks	External 25 Marks Internal 25 Marks

Course objective:
1. To define the core concepts and scope of wildlife as a vital global natural resource.
2. To examine the diverse wildlife habitats and ecological zones across the Indian subcontinent.
3. To analyze modern wildlife management techniques, protected area networks, and community-driven conservation practices in India.

Course Outcome: Having completed this course, the learner will be able to:
1. Explain the fundamental definitions, scope, and resource value of global wildlife.
2. Identify and characterize the major wildlife habitats unique to the Indian subcontinent.
3. Evaluate the role of Protected Areas (PAs), community partnerships, and current management practices in India.

Unit	Content	Credit	Hours
I	**Wildlife as Natural resource** • Wildlife: Definition, Scope and wildlife as natural resource • Conservation: Definition, History and Background and types of conservation • Significance of wildlife conservation • Wildlife habitats in Indian subcontinent	01	15
II	**Wildlife Conservation Management** • Wildlife management (History and current advances) • Protected areas and role of PAs in wildlife conservation • Community and conservation • Current wildlife conservation practices in India	01	15

	Suggested reference 1. Gadgil, M. (2002) A methodology mannual for scientific inventorying, monitoring and conservation of Biodiversity 2. Hickman C. P., et al. 2006 Integrated principals of Zoology, McGraw Hill Higher Education. 931pp. 14th edition.	

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COURSE NAME M.SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

PRACTICAL DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PDSCCES104

BASICS OF ENVIRONMENTAL SCIENCE, CURRENT ISSUES IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL POLLUTION

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 6 Hours **Total Marks: 50**

Q1		Do as directed	**10**
Q2		Do as directed	**10**
Q3		Do as directed	**05**
Q4		Do as directed.	**05**
Q5	**a**	Spoting	**10**
	b	Journal	**05**
	c	Viva-voce	**05**

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COURSE NAME M. SC. ENVIRONMENTAL SCIENCE SEMESTER I
PROGRAM CODE: SCIPGES108

PRACTICAL MULTI-DISCIPLINE SPECIFIC CORE COURSE CODE: SC2M26PMDCES106

RESEARCH DESIGN AND DATA ANALYSIS

EFFECTIVE FROM JUNE 2026-27 UNDER NEP

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q1		Do as directed	**05**
Q2		Do as directed	**05**
Q3		Do as directed	**05**
Q4		Spotting / Do as directed	**03**
Q5		Journal	**03**
Q6		Viva-voce	**04**