FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSC-08T**		
2	**Course Title**	**ORGANIC & INORGANIC CHEMISTRY-II**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Master mechanisms, kinetics, mechanism and reactivity factors in organic chemistry.*** ➢ ***Understand and predict regioselectivity in aromatic electrophilic substitution reactions.*** ➢ ***Utilize symmetry and group theory to analyze molecules and predict spectroscopic features.*** ➢ ***Understand and classify supramolecular chemistry***		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**MECHANISTIC ORGANIC CHEMISTRY** Unit I: A) Reaction mechanism: Types of reaction, Types of mechanism, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, trapping of intermediates, checking for common intermediate, competition and cross-over experiments, isotope effects, Hard and soft acids and bases. B) Reaction Kinetics: Reaction co-ordinate diagrams, rate laws and methods of determining concentration. C) Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft Equation. D) Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituent, orientation in another ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe– Schmitt reaction	12
II	**SUBSTITUTION REACTIONS** A) Aliphatic nucleophilic substitution: The SN1, SN2, mixed SN1, SN2 and SET and SNi mechanisms. Nucleophilicity, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non-classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen. Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migratory aptitude. C) Aromatic Nucleophilic Substitution: A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, SN1, benzyne and SRN1 mechanisms,	11

	arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter and Smiles rearrangements, Chichibabin amination reaction. Benzyne: Structure, methods of generations and reactions	
III	**Symmetry and Group Theory in Chemistry** Symmetry elements and symmetry operation, definition of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses in spectroscopy.	**11**
IV	**Supramolecular Chemistry:** Concepts and language, Molecular recognition Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition. Supramolecular reactivity and catalysis. **Transport processes and carrier design.** Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry. **Metal Clusters:** Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds. **Isopoly and Heteropoly Acids and Salts.**	**11**
Keywords	***Reaction mechanisms, kinetics, regioselectivity, electrophilic substitution, substitution mechanisms, neighboring group participation, symmetry, group theory, supramolecular chemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended -

Textbooks Recommended

1. *Soni, P. L., Bahl, B. S., & Bahl, A. (2019). Organic Chemistry.S. Chand & Company Ltd.*
2. *Morrison, R. T. & Boyd, R. N. (2012). Organic Chemistry. Pearson Education.*
3. *Kumar, A. (2004). Elements of Group Theory for Chemists. New Delhi, India: Affiliated East-West Press.*
4. *Mukherji, S. M. & Chakrabarti, S. P. (2007). Reaction Mechanisms in Organic Chemistry. Macmillan India Ltd.*

Reference Books Recommended

1. *Carey, F. A. & Sundberg, R. J. (2007). Advanced Organic Chemistry. Springer.*
2. *Ahluwalia, V. K. & Aggarwal, R. (2010). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Carruthers, W. (1987). Modern Organic Synthesis. Springer.*
4. *Smith, M. B. & March, J. (2006). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. John Wiley & Sons.*
5. *Grossman, R. B. (2004). The Art of Writing Reasonable Organic Reaction Mechanisms. Oxford University*

Online Resources–

- https://onlinecourses.nptel.ac.in/noc20_cy30/preview
- https://swayam.gov.in/
- https://www.coursera.org/
- https://www.edx.org/
- https://onlinecourses.nptel.ac.in/noc20_cy30/preview

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSC-08P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-VIII**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.* ➢ *To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.* ➢ *To learn about separation and purification of organic mixtures by chromatography* ➢ *To identify and characterize prepared and separated compounds by IR spectral analysis.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Organic Synthesis** (i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography. (ii) Synthesis of β-Naphthyl acetate / Hydroquinone diacetate. (iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol (iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid (v) Aldol condensation: Dibenzalacetone from benzyldehyde (vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o-chlorobenzoic acid from anthranilic acid. (vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. (viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol. (ix) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene. (x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline. (xi) Clemmenson reduction: Hydrocarbons from ketones. (xii) Nitration: Picric acid from phenol (xiii) Reduction: Acetic acid from ethanol. (xiv) Esterification: Oil of Wintergreen from salicylic acid. (xv) Sulphonation: Sulphanilic acid from aniline. **Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.** Identification of functional group of organic compounds by FTIR Separation, purification and identification of compounds of binary mixtures TLC	**30**

	and column chromatography.	
Keywords	***Organic Synthesis, Separation techniques (column chromatography, TLC), Identification techniques (FTIR), Volumetric analysis, Chromatography (paper, column), Flame photometry, Spectrophotometry (UV-Vis), Conductometry, pH-metry.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Basavarajaiah, S. M., Nagesh, G. Y., & Ramakrishna Reddy, K. (2016). *Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography*. New Age International.
2. Manna, A. K. (2011). *Practical Organic Chemistry*. Books & Allied (Publishers) Pvt. Ltd.
3. Peesapati, V. (2017). *Practical Organic Chemistry – A Primer*. BSP Books.

Reference Books Recommended:

1. Vogel, A. I. (**1957**). *Practical Organic Chemistry*. Longman Scientific & Technical.
2. Mann, F. G., & Saunders, B. C. (**2004**). *Practical Organic Chemistry* (4th Ed.). Longman.
3. Jeffery, G. H., Mendham, J., Denney, R. C., & Barnes, J. (**2000**). *Vogel's Textbook Of Quantitative Chemical Analysis* (6th Ed.). Longman.
4. Harris, D. C. (**1998**). Quantitative Chemical Analysis (5th Edition). W H Freeman & Co

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **V. Performed the Task based on lab. work - 20 Marks** **W. Spotting based on tools & technology (written) – 10 Marks** **X. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**		Session: **2024-2025**
1	**CourseCode**	**CHSE-08P**		
2	**CourseTitle**	**ELECTROCHEMISTRY AND SURFACE CHEMISTRY LAB. COURSE**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**CourseLearning.Outcomes(CLO)**	➢ ***To acquire the knowledge of surface tension*** ➢ ***To apply the principle of conductance in studying different applications.*** ➢ ***To apply various concepts of Physical Chemistry and use instruments in studying various applications.*** ➢ ***To acquire the surface tension – concentration relationship for solution***		
6	**CreditValue**	**01Credit (Practical)**	***(Credit = 30Hrs laboratory or Field learning / training)***	
7	**TotalMarks**	**Max.Marks:50**		**MinPassingMarks:20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics(Coursecontents)**	**No.of Period**
Lab./Field Training/ Experiment Contents of Course	**Conductometry** Estimation of aspirin from tablet. Determination of relative strengths of different acids. Determination of the strength of strong and weak acids in a given mixture conductometrically. **Potentiometry/pH metry** Determination of temperature dependence of EMF of a cell. To determine pK_a of the given monobasic acid by pH metric titration. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method. **Surface Tension:** Determination of CMC of Surfactants by (1) Surface Tension method (2) Conductometric method To study surface tension – concentration relationship for solution (Gibb's equation). To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm. To determine the parachor of the given liquid. Compare CMC of different surfactants by surface tension method.	**30**
Keywords	Conductometry, potentiometry, pH-metry,CMC	

SignatureofConvener&Members (CBoS):

PART–C
LearningResources:TextBooks,ReferenceBooksandOthers
Textbook Recommended 1. *Athawale, V. D., & Oza, N. R. (2001). Experimental physical chemistry. New Age International Publishers.*
OnlineResources– ➢ **SWAYAM https://swayam.gov.in** ➢ **e-Pathshala https://epathshala.nic.in**

Part-D:AssessmentandEvaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA): **(By Course Teacher)**	**Continuous Internal Assessment (CIA):** **(By Course Teacher)**	Better marks out of two Test/Quiz + obtained marks in assessment shallbe consideredagainst 15Marks
End Semester Exam(ESE):	**Laboratory/Field Skill Performance : on spot Assessment** **A: Perform task Based on the lab work- 20 Mark** **B: Spotting Based on tools and techniques- 10 marks** **C: Viva-voce (Based on principle/technology)-05 Marks**	**Managed by Course teacher as per Lab. Status.**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Honors/Honors with Research)*		**Semester–VIII**		Session:**2024-25**
1	**Course Code**	**CHSE-09T**		
2	**Course Title**	**APPLICATION OF SPECTROSCOPY -II**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ ***To interpret the vibrational spectra of molecules to identify functional groups and understand their bonding modes.*** ➢ ***To gain proficiency in analyzing NMR and ESR spectra to determine the structure and electronic environment of atoms within a molecule.*** ➢ ***To equip students with the ability to utilize Mössbauer spectroscopy for the characterization of iron-containing materials, analyzing their oxidation state and local environment.*** ➢ ***To develop the skills to interpret mass spectra, including fragmentation patterns, to determine the molecular weight and structure of unknown compounds.***		
6	**Credit Value**	**03Credit**	***Credit = 15 Hours - learning & Observation***	
7	**TotalMarks**	**Max.Marks:100**		**MinPassingMarks:40**

PART-B: Content of the Course

Total No.ofTeaching–learningPeriods (01Hr.perperiod)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Vibrational Spectroscopy** Instrumentation and sample handling in IR Spectroscopy, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. FTIR. **Optical Rotatory Dispersion (ORD)and Circular Dichroism (CD)** Definition, deduction of absolute configuration, Octant rule for Ketone	12
II	**Nuclear Magnetic Resonance Spectroscopy** General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry hindered rotation. **Carbon-13 NMR Spectroscopy** General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic,	11

	heteroaromatic and carbonyl carbon), coupling constants. **Two-dimension NMR Spectroscopy:** COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techniques.	
III	**Electron Spin Resonance Spectroscopy** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron). **Mossbauer Spectroscopy** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds - nature of M - L bond coordination number, structure and(3) Detection of oxidation state and inequivalent MBatoms.	**11**
IV	**Mass Spectrometry** Introduction, ion production - EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement.Nitrogenrule.High-resolution mass spectrometry.Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	**11**
Keywords	***Vibrational Spectroscopy, Infrared Spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Carbon-13 NMR, Two-Dimensional NMR (COSY, NOESY, DEPT, etc.), Electron Spin Resonance (ESR), Mössbauer Spectroscopy, Mass Spectrometry, Functional Group Identification, Organic Structure Determination***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources: Textbooks, Reference Books andOthers

Textbooks Recommended

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*
2. *Sharma, Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recoomended

1. *Nakamoto, K. (2009). Infrared and Raman Spectra: Inorg. and coordination compounds. Wiley.*
2. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectroscopy. in Inorg. Chem. Ellis Horwood.*
3. *Martin, M. L., Delpeuch, J. J., & Martin, G. J. (1982). Practical NMR Spectroscopy. Heyden.*
4. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
5. *Abraham, R. J., Fisher, J., & Loftus, P. (2011). Introduction to NMR Spectroscopy. Wiley.*
6. *Dyer, J. R. (1978). Application of Spectroscopy of Organic compounds. Prentice Hall.*
7. *Williams, D. H., & Fleming, I. (1990). Spectroscopic Methods in Org. Chem. Tata McGraw Hill.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://swayam.gov.in/nd1_noc19_ch08/preview
- https://www.coursera.org/learn/spectroscopy-chemistry
- https://nptel.ac.in/courses/104/106/104106050/
- https://epathshala.nic.in/e-textbook/Class%20XI/Chemistry/ChemistryIEng.pdf

PART -D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~+20~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelors in Science *(Honors/Honors with Research)*			**Semester-VIII**	Session:**2024-25**
1	**Course Code**	**CHSE-09P**		
2	**Course Title**	**SPECTROSCOPY-II LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning Outcomes(CLO)**	➢ ***Understand working principle of FTIR instrument and interpret FTIR spectrum.*** ➢ ***Interpretation of H- NMR spectra, Carbon-13 NMR and ESR spectra and identifying molecules based on chemical shifts and coupling constants.*** ➢ ***Interpretation of Mossbauer spectra and understanding its working principle.*** ➢ ***Understanding working principle of mass spectrometry and interpret mass spectrum.***		
6	**Credit Value**	**01Credit**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max.Marks:50**		**MinPassingMarks:20**

PART-B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course.	**FTIR** • To prepare the KBr pellet of an organic compound (such as benzoic acid). • To carry out a qualitative analysis of an organic compound (such as benzoic acid) using FTIR. • To identify IR absorption peaks and the corresponding functional groups of an unknown solid/liquid/powder. • To study the Optical Rotatory Dispersion (ORD) of some chiral substances.	**30**
	NMR and 13CNMR • To interpret the peaks and identify molecules/structures of NMR spectrums. • To interpret the peaks and identify molecule(s)/structures of ^{13}CNMR spectrums. • To interpret the peaks and identify molecules/structures based on both NMR and ^{13}CNMR spectrums.	
	ESR and Mossbauer • To interpret the peaks and identify the magnetic character of metal/ion based on ESR spectroscopy. • To determine the resonance magnetic field B_0 as function of the selected resonance frequency (v) and the g-factor of DPPH. • To determine the line width δB_0 of the resonance signal. • To interpret and understand the Mössbauer spectra of iron Fe and Sn complexes. • To interpret the peaks (signals) and identify metal/ions based on ESR and	

	Mössbauer spectroscopy.
	Mass Spectrometry • To interpret the mass spectrum and distinguish between different molecules (e.g., alcohols/ethers, aldehydes/ketones, acids, and other aromatic molecules). • To identify the unknown molecule(s) based on combined UV-visible, FTIR, NMR and mass spectrum data.
Keywords	***Vibrational spectroscopy, FTIR, Nuclear Magnetic Resonance (NMR), ^{13}CNMR, Electron spin Resonance (ESR Spectroscopy), Mössbauer spectroscopy, Mass Spectrometry, peaks, signals.***

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources:Text Books, Reference Books and Others

Textbooks Recommended–

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House. Sharma,*
2. *Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recommended

1. *Vij, D. R. (Ed.). (2007). Handbook of applied solid state spectroscopy. Springer Science & Business Media.*
2. *Guthrie, R. D. (1979). Introduction to Spectroscopy (Pavia, Donald; Lampman, Gary M.; Kriz, George S., Jr.).*
3. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
4. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectros. in Inorg. Chem. Ellis Horwood.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://www.scribd.com/document/431879132/Lab-Report-3-CHM-260
- https://www.scribd.com/document/68027365/Electron-Spin-Resonance-Experiment
- https://www.intechopen.com/chapters/76771
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Nuclear_Magnetic_Resonance/NMR%3A_Experimental/NMR_-_Interpretation

Part-D:AssessmentandEvaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA): 15 Marks
EndSemester Exam(ESE): 35 Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance **-05** Total Marks - **15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam(ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B.Spotting based on tools & technology (written) – 10 Marks** **C.Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. Status**

Signature of Convener & Members CBoS :

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Certificate/Diploma /Degree/Honors)*		Semester–VIII		Session:2024-25
1	CourseCode	CHSE-10T		
2	CourseTitle	SOLID STATE & NANOMATERIALS CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.* ➢ *Apply the concept of band theory to explain the behavior of conductors.* ➢ *To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles* ➢ *To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks:40

PART-B: Content of the Course

TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.of Period
I	**Crystal Defects and Non-Stoichiometry** Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies - Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colourcentres, non-stoichiometry defects. **Organic Solids** Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.	12
II	**Electronic Properties and Band theory** Metals, insulators and semiconductors, electronic structure of solids – band theory, band structure of metals, insulators, and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties- Optical reflectance, photoconduction - photoelectric effects. Magnetic properties-Classification of materials: Quantum theory of paramagnetism- cooperative phenomena - magnetic domains, hysteresis.	11
III	**Introduction to Nano-materials** Properties and uses of bulk and nano-materials; Optical, electrical and magnetic properties of nano-materials; quantum confinement, role of size and shape in nano-materials. Synthesis of nano-materials Synthesis of nano-crystals by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, semiconductor nano-particles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and **micro-**	11

	emulsion methods.	
IV	**Characterization of nano-materials** Instrumentation, operating principle, and application of Energy dispersive X-ray spectroscopy (EDAX); FTIR; X-ray diffraction; Atomic Force Microscope (AFM); Scanning Electron Microscope(SEM); Transmission Electron Microscope (TEM); UV-VIS-IR spectroscopy, Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA) **Applications of Nanomaterials:** Applications of nano in biology, nanoprobes for analytical applications, status of nanobiotechnology, future perspectives of nanobiology; nanosensors.	**11**
Keywords	***Nanomaterials, synthesis, characterization, applications, SEM, TEM, IR, UV-visible, TGA, DTA,nanosensors, nanotechnology.***	

Signature of Convener & Members (CBoS):

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

1. *Keer, H. V. (1993). Principles Of The Solid State. New Age International.*
2. *Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2006). The Chemistry Of Nanomaterials: Synthesis, Properties and Applications. John Wiley & Sons.*
3. *Kulkarni, S. K., & Kulkarni, S. K. (2015). Synthesis Of Nanomaterials—II (Chemical Methods). Nanotechnology: Principles And Practices, 77-109.*

Reeference Books Recommended–

1. *Hannay, N. B. (1973). Solid state chemistry. In Electronic Materials (pp. 505-534). Boston, MA: Springer US.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://web.mit.edu/robertsilbey/research/papers/1981-1990/rsilbey_structure_properties_organic_solid_state.pdf
- https://chem.libretexts.org/Courses/Howard_University/General_Chemistry%3A_An_Atoms_First_Approach/Unit_5%3A_States_of_Matter/Chapter_12%3A_Solids/Chapter_12.04%3A_Crystal_Defects
- https://jiwaji.edu/pdf/ecourse/chemistry/Electronic%20Properties%20and%20Band%20%20Theory.pdf
- https://www.researchgate.net/publication/259118068_Chapter_-_INTRODUCTION_TO_NANOMATER

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**
Continuous Internal Assessment (CIA): **30 Marks**
End Semester Exam (ESE): **70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~+~~**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-25**
1	**Course Code**	**CHSE-11T**		
2	**Course Title**	**NATURAL PRODUCTS & MEDICINAL CHEMISTRY**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To study the occurrence, types, structure, and analysis methods of terpenes and alkaloids and their biosynthesis* ➢ *To grasp key concepts in medicinal chemistry and drug terminology and learn importance of drug structure for activity.* ➢ *To explore specific drug classes and study the medicinal value of natural products*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Natural Products- Class, Structure and biological importance** Introduction, Natural occurrence, Classification, Uses, general structural features, general methods for structure elucidation including Hoffmann's exhaustive methylation and Emde's method. Terpenes: Isoprene rule Classification of mono- sesqui-, di- and triterpenoids, extraction and biological importance (structure and functions of camphor, citral and α-pinene).	12
II	**Alkaloids and Biosynthesis** Alkaloids: Classification, isolation and biological importance (structure and functions of papaverine, nicotine, coniine). Introduction to biosynthesis: Principles and underlying concepts Building blocks and precursors in biosynthesis (acetate, mevalonate, shikimate, etc.), Enzymatic reactions and their roles in biosynthetic pathways (polyketide synthases, terpene synthases). Biosynthesis of flavonoids and related polyphenols.	11
III	**Introduction to Medicines** Definition of a Medicinal drug, Requirements of an ideal drug, Nomenclature of drugs: Generic name, Brand name, Systematic name Definition of the following medicinal terms: Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD50, ED50, Therapeutic Index. (Explanation without including chemistry or structures) Brief idea of the following terms: Receptors, Drug-receptor interaction, Drug Potency, Bioavailability Structure-activity relationships of drug molecules, Quantiative-structure activity relationships (QSAR), binding role of –OH group,-NH_2 group, double bond, and aromatic ring.	11
IV	**Pharmaceutical Compounds** Classification, structure and therapeutic uses of antipyretics - Paracetamol (with	11

	synthesis); Analgesics-Ibuprofen (with synthesis); Antimalarials - Chloroquine (with synthesis); Antitubercular drugs - Isoniazid. An elementary treatment of Antibiotics and detailed study of chloramphenicol, Concept of sedation, hypnotics, and anesthesia Medicinal values of curcumin (haldi), azadirachtin (neem).	
Keywords	***Natural Products, Structure Elucidation, Terpenes & Alkaloids, Medicinal Chemistry, Drug Discovery, Structure-Activity Relationships (SAR), Pharmacokinetics & Pharmacodynamics, Drug Targets, Pharmaceutical Compounds***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Singh, H., & Kapoor, V. K. (1996). Medicinal and Pharmaceutical Chemistry. Vallabh Prakashan.*
2. *Singh, J., Ali, S. M., & Singh, J. (2010). Natural Product Chemistry. Pragati Prakashan.*

Reference Books Recommended –

1. *Finar, I. L., & Finar, A. L. (1998). Organic Chemistry (Vol. 2). Addison-Wesley.*
2. *Foye, W. O., Lemke, T. L., & William, D. A. (1995). Principles of Medicinal Chemistry. B.I. Waverly Pvt. Ltd.*
3. *Hertweck, C. (2012). Natural Product Biosynthesis. Springer-Verlag Berlin Heidelberg.*
4. *Patrick, G. (2017). Introduction to Medicinal Chemistry. Oxford University Press.*

Online Resources–

- https://m.youtube.com/watch?v=H2b-2msgjEE)
- (https://www.genome.jp/kegg/)
- (https://pubchem.ncbi.nlm.nih.gov/)
- (https://onlinecourses.nptel.ac.in/noc23_cy58/preview)
- (https://archive.nptel.ac.in/courses/104/106/104106106/)
- (https://nptel.ac.in/courses/104105076)

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~/20~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSE-11P**		
2	**Course Title**	**NATURAL PRODUCTS AAND MEDICINAL CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Demonstrate competence in determining the physicochemical properties of drugs relevant to their biological activity.*** ➢ ***Gain practical experience in the synthesis and characterization of common drugs.*** ➢ ***Develop skills in isolating natural products from plant sources and analyzing their purity.*** ➢ ***Evaluate the antimicrobial potential of natural product extracts or synthetic drugs.*** ➢ ***Integrate theoretical concepts of medicinal chemistry with laboratory techniques.***		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	Determination the solubility of drug at room temperature Determination of pK_a of drug value by Half Neutralization/ Henderson Hassel Balch equation Determination of Partition of co- efficient of a drug in octanol(other solvent) and water Synthesis and Characterization of some common drugs: paracetamol, Aspirin (Acetylsalicylic Acid) etc Isolation & Characterization: Isolation of the product, determine the yield, and perform characterization using melting point and infrared (IR) spectroscopy. **Antimicrobial Activity Assay:** This practical could involve testing the inhibitory effect of a common antiseptic or a natural product extract on bacterial growth using an agar diffusion assay. Isolation of natural products: Caffeine from Tea Leaves, Pigments from Flowers, Essential Oils from Leaves, Curcumin from Turmeric	**30**
Keywords	***Physicochemical properties, Drug synthesis, Drug characterization, Natural product isolation, Spectroscopy, Antimicrobial activity, Solubility, Partition coefficient***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Iyengar, M. S. (2009). Pharmacognosy and Phytomedicinal Plants. CRC Press. Organic Chemistry Laboratory Techniques. Pearson Education Limited.*
2. Gupta, Y. K. (2009). **Practical pharmaceutical chemistry - I.** CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. *Stovall, J. C. (2010). Experimental Organic Chemistry: A Miniscale and Microscale Approach. Cengage Learning.*
2. *Martin, A. (2010). Physical Pharmacy (6th ed.). Lippincott Williams & Wilkins.*
3. *Parrott, E. L. (2009). Experimental Pharmaceutics. CRC Press.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/books/NBK548557/
- https://www.sigmaaldrich.com/technical-documents/protocols/chemistry/drug-discovery-and-development/partition-coefficient-(log-p)-determination.html
- https://www.sciencedirect.com/science/article/pii/S0022354915332010
- https://www.chm.bris.ac.uk/webprojects2002/sleath/Synthesis.htm
- https://www.michiganstateuniversityonline.com/resources/chemistry/synthesis-and-characterization-of-aspirin/
- https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_124A%3A_Kauzlarich/Text/04._Infrared_Spectroscopy/4.2%3A_IR_Spectroscopy_Analysis
- https://journals.asm.org/doi/pdf/10.1128/9781555818722.ch15
- https://www.michiganstateuniversityonline.com/resources/chemistry/isolation-of-caffeine-from-tea/
- https://www.life.illinois.edu/mcb/150/SP04/LabManual/natural_products.pdf

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **50 Marks**

Continuous Internal Assessment (CIA): **15 Marks**

End Semester Exam (ESE): **35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **S. Performed the Task based on lab. work - 20 Marks** **T. Spotting based on tools & technology (written) – 10 Marks** **U. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			**Semester–VIII**	Session:**2024-2025**
1	**Course Code**	**CHSE-12T**		
2	**Course Title**	**INSTRUMENTAL METHODS OF ANALYSIS**		
3	**Course Type**	**DSE**		
4	**Pre-requisite (if, any)**	***As per Program***		
5	**CourseLearning. Outcomes(CLO)**	➢ ***Understand the importance of sampling and sample treatment.*** ➢ ***Select appropriate sampling technique based on sample and target analyte.*** ➢ ***Explain principle and instrumentation involved in AAS.*** ➢ ***Deduce the necessity to remove interferences in AAS and methods involved.*** ➢ ***Select proper technique among the available techniques.*** ➢ ***Formulate experiments based on optical and electroanalytical techniques.***		
6	**Credit Value**	**03Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max.Marks:100**		**MinPassingMarks:40**

PART-B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Sampling and sample treatment:** Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Detection and quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Methods of quantification: Absolute method, comparison method, calibration curve method, standard addition method and internal standard method.	11
II	**Polarography and amperometry** Polarography: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.	12

	Amperometric titrations: Principle, types and applications in analytical chemistry.	
III	**Atomic absorption spectroscopy**: Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapors and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.	**11**
IV	**Miscellaneous techniques** **Fluorometry and phosphorimetry:** Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications. **Nephelometry and turbidimetry:** Principle, instrumentation, and applications. **Photoacoustic spectroscopy:** Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS	**11**
Keywords	***Sample, sample treatment, Polarography, Amperometry, Atomic absorption spectroscopy, Instrumentation, fluorometry, Phoshorimetry, Nephelometry, turbidimetry,Photoacoustic spectroscopy.***	

SignatureofConvener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. *Bhatt, B. I., & Vora, S. M. (2008). Stoichiometry (2nd ed.). Tata McGraw-Hill Publishing Company Ltd.*
2. *Chatwal, G., & Anand, S. (2013). Instrumental methods of analysis. Himalaya Publishing House.*
3. *Khopkar, S. M. (2003). Basic concepts in analytical chemistry. New Age International Publishers*

Reference Books Recommended–

1. *Anderson, R. (1986). Sample pre-treatment and separation. John Wiley and Sons.*
2. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1986). Vogel's textbook of quantitative inorganic analysis. ELBS.*
3. *Braun, R. D. (2004). Instrumental methods of chemical analysis. Tata McGraw-Hill Education.*
4. *Christian, G. D. (2013). Analytical chemistry. Wiley India.*
5. *Day, R. A., & Underwood, A. L. (1986). Quantitative analysis. Prentice-Hall of India.*
6. *Ewing, G. W. (1975). Instrumental methods of chemical analysis. G. W. Ewing.*
7. *Meites, L., & Thomas, H. C. (1977). Advanced analytical chemistry. McGraw-Hill.*
8. *Meites, L., & Thomas, H. C. (1990). Advance analytical chemistry: Meites and Thomas. McGraw-Hill.*
9. *Skoog, D. A., & West, D. M. (1976). Fundamentals of analytical chemistry.*
10. *Shyder, L. R., & Harvath, C. H. (1983). An introduction to separation science. Wiley Interscience.*
11. *Sane, S. S., & Joshi, M. V. (2011). Electroanalytical chemistry. Quest Publications.*
12. *Kolthoff, I. M., & Lingane, J. J. (1952). Polarography.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://people.umass.edu/~mcclemen/581Sampling.html
- https://nptel.ac.in/courses/104105084
- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf

- https://mvpsvktcollege.ac.in/wp-content/uploads/2022/11/1-TYAAS.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/FLUORIMETRY.pdf
- https://courseware.cutm.ac.in/wp-content/uploads/2020/06/nephelometry-and-turbidimetry.pdf
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Photoacoustic_Spectroscopy

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20 ~~+~~20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			**Semester-VIII**	Session:**2024-2025**
1	**Course Code**	**CHSE-12P**		
2	**Course Title**	**INSTRUMENTAL METHOD OF ANALYSIS LAB. COURSE-I**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	➢ *Understanding fundamental principles of polarography and amperometry.* ➢ *Understand the working principle of UV-visible and Atomic absorption spectroscopy.* ➢ *Handling and working with Fluorometer, understanding fluorescence quenching.* ➢ *Handling of flame photometer instrument.* ➢ *To determine concentration of ions in different samples by Nephelo-Turbidometry.*		
6	**Credit Value**	**01Credit**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max.Marks:50**		**MinPassingMarks:20**

PART-B: Content oftheCourse		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics(Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course.	**Polarography and Amperometry:** • Determination of half wave potential E1/2 and unknown concentration of Cu or Pb or Zn ion. • Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.	**30**
	Absorption spectroscopy: Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy • Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds. • To determine lambda max (λ_{max}) of phenol and effects of solvents on absorption spectra of phenol. • Assay of paracetamol by UV- Spectrophotometry • To determine the amount of Ca in a sample using the standard calibration curve- Atomic Absorption Spectroscopy (AAS).	
	Fluorimetry and Flame Photometry: • To perform the assay of Riboflavin tablets by fluorimetry • Estimation of quinine sulfate by fluorimetry • Study of quenching of fluorescence • To study the effect of concentration in fluorescence intensity of quinine	

	sulphate solution. • To determination concentration of sodium in given unknown sample by Flame photometry • To determination concentration of potassium in given unknown sample by Flame photometry
	Nephelometry and turbidimetry: • To determine phosphate ion concentration in water sample by Nephelo-Turbidometry. • To determine sulphate and/or chloride ion concentration in water sample by Nephelo-Turbidometry.
Keywords	***Polarography, Amperometry, Absorption Spectroscopy, Fluorimetry, Flame Photometry, Nephelometry, Turbidimetry, Fluorescence, Lambda Max, Absorbance, concentration.***

Signature of Convener & Members (CBoS) :

PART–C,

Learning Resources: TextBooks, Reference Books and Others

Textbooks Recommended–

1. *Sharma, B. K. (1981). Instrumental methods of chemical analysis. Krishna Prakashan Media.*
2. *Badwaik, H. R., Thote L.K.; Giri, T.K. (2022). Practical Handbook: Instrumental methods of analysis. Vallabh Prakashan. Delhi, India.*
3. *Sethi, P. D. (1985). Quantitative analysis of drugs in pharmaceutical formulations. Unique Publishers.*

Reference Books Recommended–

1. *Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. (No Title).*
2. *Stenlake, J. B. (1976). Practical pharmaceutical chemistry. Athlone Press.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf
- https://mlrip.ac.in/wp-content/uploads/2022/03/INSTRUMENTAL-METHODS-OF-ANALYSIS-LAB-MANUAL.pdf
- https://www.studyandscore.com/studymaterial-detail/flame-photometer-principle-components-working-procedure-applications-advantages-and-disadvantages
- https://www.youtube.com/watch?v=DFQd0Ncj76w
- https://www.studocu.com/en-ie/document/national-university-of-ireland-maynooth/analytical-chemistry/ch202-experiment-7-atomic-absorption-spectroscopy-determination-of-the-amount-of-copper-and-zinc/7019987
- https://www.scribd.com/document/434710621/EXP-4-AAS

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** ~~+20~~ Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Honors)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSC –VIII T**		
2	**Course Title**	**Molecular biology and Biostatistics**		
3	**Course Type**	**Discipline Specific course (DSC)**		
4	**Pre-requisite** (if, any)	*As per program*		
5	**Course Learning. Outcomes (CLO)**	➢ Students shold know about cellular and gene regulation to understand genomic functions ➢ Understand the concept of 'one gene one enzyme hypothesis' along with the molecular mechanism of mutation ➢ Students will be familiar with the genetic material DNA structure its role and defects and repairing ➢ Students will be familiar with the RNA structure its role ➢ Students will be familiar with data handling.		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Nucleic acids:** Carriers of genetic information. Introduction, DNA as the carrier of genetic information (Griffith's, McLeod & McCarty experiment). The Structures of DNA and RNA / Genetic Material DNA Structure: Watson and Crick model, Salient features of double helix, Organization of DNA Prokaryotes, Viruses, Eukaryotes. Types- A-DNA, B-DNA C- DNA Z- DNA RNA Structure –mRNA, tRNA and rRNA Organelle DNA -- mitochondria and chloroplast DNA. The replication of DNA Chemistry of DNA synthesis General principles – bidirectional, semiconservative and semi discontinuous replication Enzymes involved in DNA replication.	12
II	**Mutation and DNA repair** Structural and numerical changes in the chromosomes- chromosomal aberration- duplication, deletion, inversion, translocation, gene mutation- transition and transversion, polyploidy- euploidy and aneuploidy., DNA damage and repair	11
III	**Protein synthesis and gene regulation** Genetic code Genetic code (deciphering and salient features) Transcription Concept of central dogma, Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Gene silencing. Processing and modification of RNA Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' polyA tail). Translation Ribosome structure and assembly, mRNA; aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.	11
IV	**Biostatistics** : Graph, central tendancy (Mean, median and mode) Standard Deviation, Standard error Chi square test, regression, degree of freedom	11
Keywords	*DNA, RNA, protein synthesis, gene regulation, central tendancy*	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th ed.
3. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
4. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
5. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
6. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.

Reference books:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
2. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
3. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. 6. W. H. Freeman and Co., U.S.A. 10th edition.
4. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Online Resources–

- **e-Resources / e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.springer.com/gp/book/9789811391767
- https://www.springer.com/gp/book/9789811550720
- https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx
- https://www.mooc-list.com/tags/genetics
- https://www.coursera.org/learn/genetics-evolution
- https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

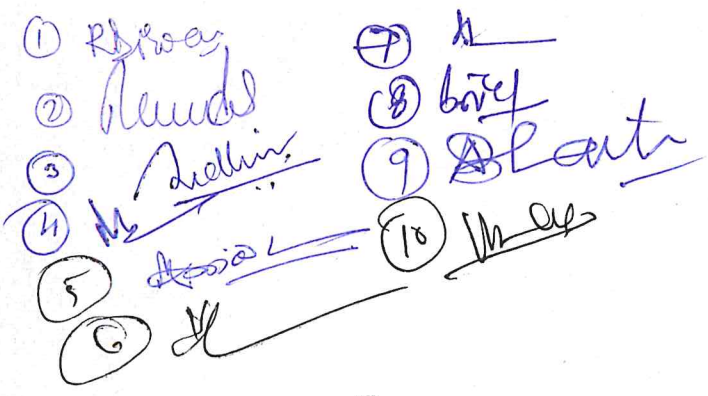
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction			
Program: Bachelor in Life Sciences *(Honors)*		**Semester - VIII**	**Session: 2024-2025**
1	Course Code	**BOSC -08**	
2	Course Title	**Lab. Course-08 (Molecular biology and Biostatics)**	
3	Course Type	**Laboratory course**	
4	Pre-requisite (if, any)	***As per program***	
5	Course Learning. Outcomes (CLO)	After the completion of the course the students will be able to: ➢ Isolate DNA from plant cell and *E.Coli.* ➢ Learn chimera formation in various plants. ➢ Understand the functioning and application of spectrophotometer. ➢ Understand the interpretation of data with the help of statistical data.	
6	Credit Value	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	Total Marks	**Max. Marks: 50**	**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Isolation of DNA from plant cells. ➢ Quantitative measurement of DNA by Spectrophotometric method. ➢ Feulgen or hydrolytic staining of DNA. ➢ Chimera formation in Bougainvillea and other ornamental and other different plants. ➢ Isolation of plasmid DNA from *E. coli* . ➢ Isolation of *Rhizobium* from root nodules of leguminous plants. ➢ Isolation of *Agrobacterium tumifaciens* from tumours of dicot plants. ➢ Preparation of LB medium and raising E. Coli. ➢ DNA estimation by diphenylamine reagent/UV Spectrophotometry. ➢ Analysis of statistical data: Statistical tables, Central tendency - mean mode, median, standard deviation and standard error (using seedling population /leaflet size etc). ➢ Calculation of correlation coefficient values and finding out the probability. ➢ Computer application in biostatistics - MS Excel and SPSS	**30**
Keywords	***Spectrophotometer, Plasmid, colchicine, E.Coli, Central tendencies.***	

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. . Raghvan, V. (1997) Molecular Biology of Flowering Plants. Cambridge Univ. Press, New York, USA.
2. Biotechnology by B.D. Singh
3. Biotechnology by R.S.Singh
4. Practical Biotechnology: Principles and Protocols by Swagat Kumar Das Hrudayanath Thatoi, Supriya Dash.

Reference Books Recommended –

1. ***Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.***
2. Brown, T. A. (1999) Genomes. John Willey and Sons Asia Pvt. Ltd., Singapore.
3. Callow, J. A. Ford-Loyd, B. V. and Newbury, H. J. (1997) Biotechnology and Genetic Resources: Conservation and Use. Cab International, Oxon, UK.
4. Glazer, A. N. and Nikaido, H. (1995) Microbial Biotechnology. Freman and Company, New York, USA.
5. Hennery, R. J. (1997) Practical Applications of Plant Molecular Biology. Chapman and Hall, London UK.
6. Jolles, O. And Jornvali, H. (2000) Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
7. Old, R. W. Primerose, S. B. (1989) Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford UK.
8. Primrose, S. B. (1995) Principles of Genome Analysis, Blackwell Scientific Publications, Oxford, UK

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4890884/
- https://www.k-state.edu/wgrc/electronic_lab/feul_stain_prot.html
- https://www.westga.edu/academics/research/vrc/assets/docs/spss_basics.pdf
- https://www.analyticsvidhya.com/blog/2021/11/a-comprehensive-guide-on-microsoft-excel-for-data-analysis/
- https://handelsmanlab.discovery.wisc.edu/wp-content/uploads/2018/01/Arapidmethod1989.pdf
- https://byjus.com/maths/central-tendency/

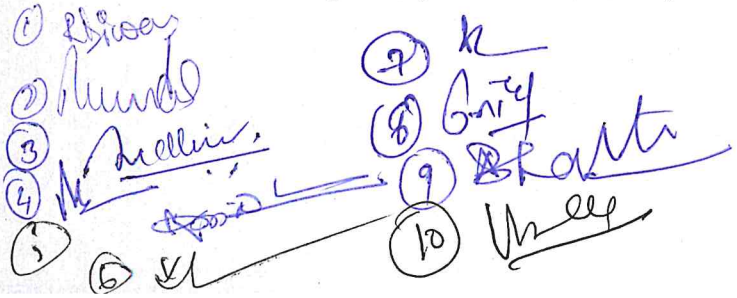
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester -VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE -09 T**		
2	**Course Title**	**Plant Biotechnology and Crop Improvement**		
3	**Course Type**	**Discipline specific Elective (DSE)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	□ At the end of this course, the students will be able to ➢ The basic concept,scope and significance of Biotechnology. ➢ Micropropagation using meristem and shoot cultureto produce large number of identical individuals. ➢ The role of biotechnology in crop improvement. ➢ Various applications of Biotechnology in different fields.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course		
Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)		
Unit	**Topics (Course contents)**	**No. of Period**
I	**Fundamentals of Biotechnology:** Basic concepts, principles and scope. **Plant Cell and Tissue Culture:** General concept, history, scope, totipotency, concept of cellular differentiation, tissue culture media and explants. Applications of Plant Biotechnology.	**12**
II	**Organogenesis and Embryogenesis:** Concept of morphogenesis, organogenesis and embryogenesis; Fundamental aspects of organogenesis in plant tissue culture, factors influencing organogenesis; somatic embryogenesis and androgenesis - mechanism, techniques and utility.	**11**
III	**Somatic Hybridization:** Concept of somatic fusion and hybridization; Protoplast isolation, fusion and culture, hybrid selection and regeneration; progress, possibilities, achievements and limitations of protoplast research.	**11**
IV	**Application of Plant Tissue Culture in crop improvement:** Clonal propagation, artificial seed, production of hybrids and soma clones, Soma clonal variation – cause & advantages and its application in crop improvement; production of secondary metabolites / natural products, cryopreservation and germplasm storage.	**11 (11Hr))**
Keywords	Biotechnology, Tissue Culture, Crop improvement, Clonal propagation	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bhojwani, S. S and Razdan, N.K. (1996) Plant Tissue Culture: Theory and Practice, Elsevier Science Publishers, New York, USA
2. .Kartha, K.K. (1985) Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
3. Vasil, I. K. and Thorbe, T. A. (1994) Plant Cell and Tissue Culture. Kluwer Academic Publishers, Netherlands.

Reference Books Recommended –

1. Smith, R. H. (2000) Plant Tissue Culture; Techniques and Experiments, Academic Press,New York.
2. Collins, H.A. and Edwards, S. (1998) Plant Cell Culture, Bios. Scientific Publisher Oxford, U.K.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-biotechnology#:~:text=Plant%20Tissue%20Culture%2DBased%20Industries&text=Plant%20tissue%20culture%20in%20agricultural,into%20next%20step%20of%20commercialization.**
- **https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology**
- **https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-022-00369-2**
-

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE-09 P**		
2	**Course Title**	**Lab. Course -09 (Plant biotechnology and crop improvement)**		
3	**Course Type**	**Laboratory course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, the students will be able to understand- ➢ The basic techniques of Plant Tissue Culture. ➢ Screening programmes of cells, rather than plants, for advantageous characters. ➢ The biochemical and physiological aspects of plant growth. ➢ How to explore entrepreneurship avenues in this field.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	1. Familiarization with basic equipments in tissue culture. 2. Preparation of tissue culture (MS) medium. 3. Study of techniques of tissue culture: sterilization of glass wares and plant materials, transfer of explants on culture media, incubation.Up to callus formation 4. Initiation of organogenesis and embryogenesis using appropriate explants. 5. Isolation of plant protoplast by mechanical and enzymatic method 6. Test of viability by tetrazolium chloride (TZ) method. 7. Counting of protoplast in the suspension by haemocytometre method 8. Effect of physical and chemical factors in protoplast yield. 9. Demonstration of protoplast fusion employing PEG. 10. Visit to any tissue culture lab of your locality and a prepare project report.	**30**
Keywords	Medium, protoplast, tissue culture, TZ	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. "Plant Tissue and Organ Culture fundamental Methods" by Gamburg OL and Philips GC, Publisher – Springer- verlag Heidelberg GmbH & Co. K
2. Practical Biotechnology by Ramadass Jaypee Brothers Medical Publishers

Reference Books Recommended

1. Biotechnology : fundamental and application by Ashok Ganguli, Publisher- Oxford book company

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-biotechnology#:~:text=Plant%20Tissue%20Culture%2DBased%20Industries&text=Plant%20tissue%20culture%20in%20agricultural,into%20next%20step%20of%20commercialization.**
- **https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology**
- **https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/s40066-022-00369-2**

Online Resources–

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- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE -10 T**		
2	**Course Title**	**Applied Botany and Intellectual property right (IPR)**		
3	**Course Type**	**Discipline specific Elective (DSE)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of the course,the students will be able to: ➢ Understand the scope and importance of Social forestry and establishment of orchard. ➢Learn silvics of some important timber plants of India. ➢Learn post-harves tmanagement,marketing and value additionof commercial ornamental plants. ➢ Develop a deep understanding of different forms of intellectual property Rights (IPR)		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course		
Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)		
Unit	**Topics (Course contents)**	**No. of Period**
I	**Social forestry**: Introduction, Definition, scope and objectives of social forestry. Classification of social forestry, Economic importance of social forestry, important scheme, choice of species for reclamation of waste land, over damp area, saline and alkaline area .**Layout and Establishment of Orchards**:Pruning and training; propagation, Climatic requirement and cultivation ffruits likeMango,Banana,Citrus, Guava.	**12**
II	**Sliviculture:**Definition,objective and scope of silviculture. Status of forest in India and their role.Trees and their distinguishing features.Regeneration:Natural,artificial and factors Affecting it.Regeneration Survey.Tending operation:Weeding,cleaning,thinning and improvement felling. Silivcs of important forest tree species e.g. Teak, Shorea, Sheesam .	**11**
III	**Floriculture;**History of Floriculture. Importance and scope of floriculture in India. Flower production –water and nutrient management, weed management, thinning and pruning, disbudding, use of growth regulators, physiological disorders and remedies,Harvesting techniques,post-harvest handling, pre-cooling,pulsing,packing, storage & transportation. Prolonging the vase life of flowers. Marketing and export potential of flowers, institutional support.	**11**
IV	IPR: Definition and significance of intellectual propertyrights(IPR), Overview of different types of IPR,including patents and it's filingprocess, copyrights, trademarks their registration and infringement, trade secrets,Historical development and international frame works forprotecting IPR,Salient feature of Patent Act 1970.	**11**
Keywords	***Social forestry, Orchard, Harvesting technique,Trademark***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended–

1. S, S, Negi: Social forestry
2. S.A.Shah & K .M .Tiwari: Forestry and people
3. G.P.D.Vyas: Social forestry and rural development
4. Jyoti Rattan 2024.Intellectual Property Rights

Reference Books Recommended –

1. Khanna,L.S.(1984).Principles and Practice of Silviculture,Khanna Bhandu,DehraDun.
2. Ram Prakash and L.S.Khanna.(1991)Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.
3. Champman ,G.W.and Allan,T.G.(1978).Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.
4. Anonymous.(1976)Indian forest utilization.Volume Iand III CFRE Publication,Dehradun.
5. Mehta,T.(1981)A hand book of forest utilization.Periodical Expert Book Agency,Delhi.298

OnlineResources –

e-Resources/e-books and e-learning portals

www.ipindia.gov.in

www.wipo.int/aboutip/en/

www.india.gov.in /topics/agriculture/floriculture

littps://byjus.com/free-ias-prep/ipr-in-india-upsc notes/

https://vikaspedia.in/agriculture/farm-based-enterprises/floriculture

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE-10 P**		
2	**Course Title**	**Lab. Course -10 (Applied Botany and Intellectual Property Rights)**		
3	**Course Type**	**Laboratory course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, students will be able to: ➢ Understand forest structure and composition. ➢ Get knowledge about phenology of various species. ➢ Learn nursery bed preparation technique. ➢ Analyze the density and moisture content of wood.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Study of forest composition. • Recording the observations on phenological characteristics of different tree species. • Study of the natural and artificial regeneration. • Lay outing of nursery bed and soil preparation, types of seed sowing in nursery bed. • Study of gross features of different types of wood; straight interlocked, spiral and wavy grain, texture, lusture, etc. • Study ofcharacteristics of trees/shrubs/grasses for agroforestry. • Volume and biomass estimation. • Crown measurement. • Study of vase life extension in cut flower using chemicals. • Study and description of botanical features of floricultural plants studied in theory paper. • Drafting a patent application: Students can learn how to draft a patent application for a new invention . • Trademark registration process: Students can learn how to register a trademark in India.	**30**
Keywords	***Phenological, Wood grain,Nnursery bed, Regeneration***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Chundawat D S and Gautam SK (2010) Textbook of agroforestry. Oxford and IBH publishing co pvt. Ltd.
2. . Nair, P.K.R. (1993) An introduction to agroforestry. Kluwer Academic Publishers. 499 p. 4. Huxley, P. (1999) Tropical agroforestry. Blackwell Science, Oxford.
3. Khosla, P.K. and Khurana, D.K. (1987) Agroforestry for rural needs. Vol. I and II, ISTS, Solan, H.P.
4. Ong, C.K. and Huxley, P.K. (1996) Tree crop interactions - A physiological approach. ICRAF, Kenya.
5. . Ramakrishnan, P.S. (1992) Shifting agriculture and sustainable development. Man and biosphere series. The Parthenon Publishing Group.
6. . SenSarma, P.K. and Jha, L.K. (1993) Agroforestry. Indian Perspectives. Ashish Publishers, Delhi.5. Khanna, L. S. (1984). Principles and Practice of Silviculture, KhannaBhandu, Dehra Dun.
7. 7 . Ram Prakash and L.S. Khanna. (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.

Reference Books Recommended –

1. Champman, G.W. and Allan, T.G. (1978). Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.
2. Anonymous. (1976) Indian forest utilization. Volume I and II ICFRE Publication, Dehradun.
3. Mehta, T.(1981) A handbook of forest utilization. Periodical Expert Book Agency, Delhi. 298
4. "Floriculture Principles and Species" by Dhiman Mukherjee
5. "Floriculture in India" by Jyotsna Singh and Ramesh Chandra
6. "Floriculture: A Basic Guide" by K.V. Peter
7. "Handbook of Flowering" by Jitendra Kumar
8. "Commercial Floriculture: Principles and Practices" by A.P. Misra and V.P. Singh
9. Intellectual Property Rights and Biotechnology by Shashikala Gurpur and Sreenivasulu N.S.
10. Intellectual Property Rights and Plant Biotechnology by Ramanujam Srinivasan
11. Intellectual Property Rights: An Overview by Arul George Scaria

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://ipindia.gov.in/form-and-fees.htm
- https://www.indiafilings.com/trademark-registration?matchtype=e&device
- https://www.youtube.com/watch?v=S7F6bCRBUDg&t=111s
- https://www.youtube.com/watch?v=SrWcYWzJJJ8
- https://www.youtube.com/watch?v=tYysC0dwtU0
- https://www.youtube.com/watch?v=U5_nynPVdTY
- https://www.youtube.com/watch?v=7faqx7N-pS4
- https://www.youtube.com/watch?v=AQdEXkVFGEw
- https://www.youtube.com/watch?v=uDWilCvc3lQ

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE -11 T**		
2	**Course Title**	**Biochemistry and Enzymology**		
3	**Course Type**	**Discipline specific Elective (DSE)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, the students will be able to ➢ Basic idea of life building block biomolecules. ➢ Energy status of the cell ➢ Basic carbohydrates, lipids and proteins structure ➢ Biocatalyst enzymes		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	• Structure of atoms, molecules and chemical bonds. • Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). • Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).. • Composition, structure and function of biomolecules (carbohydrates,).	12
II	• Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. • Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP.	11
III	• Lipids : structure and function, alpha and beta oxidation and anabolism. • Nucleic acids : DNA, RNA, Conformation of nucleic acids (helix (A, B,C, Z), t-RNA, mRNA, rRNA, HnRNA micro-RNA).hoogestein bridge, hairpin DNA	11
IV	• Proteins- amino acids, primary, secondary, tertiary and quaternary structure. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). • Fundamentals of Enzymology: General aspect, classification, nature of enzymes, mode of enzyme action, allosteric mechanism, feedback method of inhibition, regulatory and active sites, isoenzymes, Ribozyme,Abzymes, kinetics of enzymatic catalysis, Michaelis – Menton equation and its significance.	11
Keywords	reaction kinetics, inhibition. active sites, Conformation, ATP	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books recommended:

1. Galaston, A. W., (1989) Life Processes in Plants. Scientific American Library, Springer- Verlag, New York, USA.
2. Hopkins, W. G. (1995) Introduction to Plant Physiology John Willey and Sons, Inc. New York, USA.
3. Dennis D. T., Turpin, D. H., Lefebvre D. D. and Layzell, D. B. (1997) Plant Metabolism. Longman, Essex, England.
4. Moore, T. C. (1989) Biochemistry and Physiology of Plant Hormone. Springer Verlog, New York.
5. Nobel, P. S. (1999) Physiochemical and Environmental Plant Physiology. Academic Press, San Diego, USA.
6. Thomas, B. and Vince-Prue(1997) Photoperiodism in Plants. Academic Press; San Diego, USA.

Reference Books Recommended-

1. Taiz, L. and Zeiger, E., (1989) Plant Physiology. Sinaver Associations, Inc. Publishers, Masssachusetts, USA.
2. Salisbury F. B. and Ross, C. W., (1992) Plant Physiology Wadsworth Publishing Co., California, USA
3. Lehninger : Principles Of Biochemistry by David L Nelson, Michael M Cox 2021

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. **https://www.mdpi.com/journal/biomolecules**
2. **https://www.news-medical.net/life-sciences/An-Overview-of-Enzymology.aspx#:~:text=Enzymology%20is%20the%20study%20of,products%20controlled%20by%20equilibrium%20properties.**
3. **https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/06%3A_Metabolism/6.02%3A_Energy_and_Metabolism_-_Types_of_Energy**
4. **https://www.thoughtco.com/dna-versus-rna-608191**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA):30 **(By Course Teacher)**	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester -VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE -11 P**		
2	**Course Title**	**Lab. Course -11 P (Biochemistry and enzymology)**		
3	**Course Type**	**Laboratory course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	➢ Students will be familiar with the common biobuilding block ➢ Biochemical analysis of common biomolecules ➢ Enzyme kinetics and its role ➢ Characterization of light harvesting molecule chlorophyll.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	1) Biochemical test of carbohydrates, sucrose, glucose proteins, lipids 2) Biochemical test of Catalase, dehydrogenase, peroxidase test 3) Preparation of chlorophyll extract 4) Separation of chlorophyll by paper chromatography. 5) Separation of chlorophyll amino acids by paper chromatography. 6) Effect of temperature on enzyme activity 7) Effect of pH on enzyme activity	**30**
Keywords	Biochemical test, Catalase, dehydrogenase, chlorophyll, enzyme	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Practical Biochemistry by Damodaran Geetha K (Author) Jaypee Brothers Medical Publishers
2. *Practical Manual of Biochemistry,* CBS Publishers & Distributors Pvt. Ltd. (1 January 2020); CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. Introductory Practical Biochemistry Paperback – 2 January 2001by S.K. Sawhney (Editor), R. Singh (Editor) Narosa Publishing House
2. Practical Enzymology Author(s): Prof. Dr. Hans Bisswanger First published:23 February 2011Print ISBN:9783527320769 |Online ISBN:9783527659227 |DOI:10.1002/9783527659227 Copyright © 2011 Wiley-VCH Verlag GmbH & Co. KGaA

Online Resources–

- **e-Resources / e-books and e-learning portals**

1) **https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=KAUSHIK+G+G&search-alias=stripbooks**
2) **https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.mlsu.ac.in/econtents/1616_Biochemical%20Tests%20of%20Carbohydrate,%20protein,%20lipids%20and%20salivary%20amylase.pdf**
3) **https://alevelbiology.co.uk/notes/tests-for-carbohydrates/**
4) **https://alevelbiology.co.uk/notes/test-for-proteins/**
5) **https://studymind.co.uk/notes/test-for-lipids-and-proteins/**
6) **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4121948/**

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE- 12 T** Genetic		
2	**Course Title**	**Bioinformatics and Gene Technology**		
3	**Course Type**	**Discipline specific Elective (DSE)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	*At the end of the course, the students will be able :* ➢ Understand basics of bioinformatics and it's tools. ➢ Learn application of bioinformatics in various areas. ➢ Analyse and perform RAPD,RFLP,PCR etc. ➢ Understand GMO and ethics behind the cloning.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Introduction to Bioinformatics:**Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Biological Databases,Basic bimolecular concepts: Protein, and amino acid, DNA & RNA, Sequence Classification format ofBiological Databases.. National Center for Biotechnology Information (NCBI),Examples of related tools(FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB .	12
II	**Applications of Bioinformatics** :Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, protein sequencing, gene sequencing, Crop improvement.	11
III	**Genetic technology** :Recombinant DNA technology; restriction endonuclease, cloning vectors. Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting;Molecular DNA markers i.e. RAPD, RFLP. DNA sequencing, PCR and ReverseTranscriptase-PCR.	11
IV	**Application of genetic technology**: Genetically modified organism; bt cotton and btbrinjal.Transgenic crop; Golden rice. *Agrobacterium* transformation,Hybridomaand monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy, social, legal and ethical aspect of cloning.	11
Keywords	***Bioinformatics, Durg design, Crop improvement, ELISA***	

Signature of Convener & Members (CBoS) :

1 2 3 4 5 6 7 8 9 10

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
4. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A

Reference Books Recommended –

1. Mount D., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York. (2004).
2. Baxevanis, A.D. and Francis Ouellellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
3. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
4. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley- Blackwell.
5. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://pubmed.ncbi.nlm.nih.gov/24272431/#:~:text=Bioinformatics%20is%20an%20interdisciplinary%20field,a%20computational%20point%20of%20view.
- https://byjus.com/biology/bioinformatics/
- https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
- https://www.geeksforgeeks.org/types-of-biological-database-in-bioinformatics/
- https://www.umass.edu/microbio/rasmol/techintr.htm#:~:text=RasMol%20is%20a%20molecular%20graphics,generation%20of%20publication%20quality%20images.
- https://www.intechopen.com/chapters/88596
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9696050/#:~:text=Bioinformatics%2C%20next%2Dgeneration%20sequencing%2C,improving%20crop%20quality%20%5B87%5D.
- https://www.enzolifesciences.com/science-center/technotes/2017/march/what-are-the-differences-between-pcr-rt-pcr-qpcr-and-rt-qpcr?/
- https://education.nationalgeographic.org/resource/genetically-modified-organisms/

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honours)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**BOSE -12 P**		
2	**Course Title**	**Lab. Course -12 (Bioinformatics and Gene Technology)**		
3	**Course Type**	**Laboratory course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, students will be able to: ➢ Retrieve gene and protein from gene bank. ➢ Understand steps of production of GMO. ➢ Learn the isolation of plasmid DNA. ➢ Understand use and application of PCR.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	• Retrieve the gene from Gene bank and to save the sequence in FASTA format. • Retrieve the protein from Gene bank and to save the sequence in FASTA format. • Find the similarity of sequence for the given nucleotide or protein sequence. • Find the similarity of sequence for the given protein sequence. • Study of steps of genetic engineering for production of Bt cotton, Golden rice through photographs. • Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, micro projectile, bombardment. • Isolation of plasmid DNA. • Restriction digestion and gel electrophoresis of plasmid DNA. • Demonstration of PCR.	**30**
Keywords	***Gene bank , FASTA, Agrobacterium, PCR***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Baxevanis, A.D. and Francis Ouellellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009).
4. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.

Reference Books Recommended –

1. Sarma,P V G K , 2021.A Practical Textbook of Genetic Engineering in Bacteria .
2. Yves Tourte, 2003 . Genetically Modified OrganismsTransgenesis in Plants

Online Resources–

- **e-Resources / e-books and e-learning portals**

- https://vvvcollege.org/dbt/LabManual-Bioinformatics.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI0505%20LAB%20MANUAL.pdf
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7712542/#:~:text=Transfer%20the%20supernatant%20that%20contains,the%20purity%20of%20the%20DNA.
- https://miteshshrestha.wordpress.com/wp-content/uploads/2018/03/flavr-savr-tomato-golden-rice-bt-cotton.pdf
- https://www.deshbandhucollege.ac.in/pdf/resources/1589512616_Z(H)-VI-Biotech-1.pdf
- https://bio.libretexts.org/Bookshelves/Biotechnology/Lab_Manual%3A_Introduction_to_Biotechnology/01%3A_Techniques/1.12%3A_Restriction_Digest_with_Gel_Electrophorisis
- https://www.youtube.com/watch?v=matsiHSuoOw

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors / Honors With Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSC-08T**		
2	**Course Title**	**Biotechniques**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite (if, any)**	***As per program***		
5	**Course Learning Outcomes (CLO)**	***At the end of course, students will be able to -*** ➢ Have comprehensive understanding of various tools and techniques commonly employed in scientific research across disciplines ➢ Learn utilizing essential laboratory instruments such as microscopes, pH meter, spectrophotometers, chromatography systems, and centrifuges. ➢ Understand cell culture techniques ➢ Develop skills in experimental design, data acquisition, and analysis using modern software tools. ➢ Develop critical thinking on the application of various modern instruments and correlate the knowledge for better development of society.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Microscopy and Microtomy: Types of Microscope:** Basic Principle, configuration and working of Light Microscope (Bright and Dark Field), Magnification & Resolution, and Numerical Aperture. Phase Contrast Microscope, Fluorescence Microscope, Confocal Microscope. Electron Microscope (SEM and TEM). **Microtomy**: Permanent slide preparation through microtome: Tissue - preparation fixation, dehydration, **block** - preparation, trimming, **cutting sections (sectioning /Ribbon)** - handling, affixing on the side, labeling and storage, **staining** the microtomy slides.	**11**
II	**Tools and techniques in Physiology:** Principle and applications of pH meter, Centrifugation, Colorimetry and Spectrophotometry- UV, visible spectrophotometer, Infra-red spectrophotometer, NMR and ESR.	**11**
III	**Chromatography and Eletrophorosis: Chromatography:** Principle and Applications of Paper chromatography, Thin layer chromatography and Gel-filtration chromatography. **Electrophoresis:** Principle and Applications of Agarose gel electrophoresis, Polyacrylamide Gel electrophoresis, PAGE, 2D PAGE.	**12**
IV	**Cell culture and Lab Bioethics:** Cell culture and its basic requirements. **Culture media:** Nutrient and Non-nutrient media, Types of animal cell culture: Pure Culture- Pour Plate Method, Streak Plate Method and Spread Plate Method. **Media preparation** of Animal Cell culture, viability testing, cell harvesting and storage method with special reference to Lymphocytes and stem cell culture. *In Vitro* culture of Entamoeba *histolytica, Coenorhabditis elegans*. **Sterilization technique** (Physical Method: Autoclave sterilization, Hot air Sterlization, U V sterilization, filtration and chemical Method: alcohol, Formalin and Chromic acid), sterilization of glass wares, Media and laminar flow, Flow cytometery. **Lab Bioethics:** Lab safety, disposal of bio-waste.	**11**
Keywords	*Cell culture, Sterilization, Cryopreservation, Media, viability testing, cell harvesting, Lymphocytes, stem cell.*	
	Signature of Convener & Members (CBoS) :	

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Robert Braun, Introduction to instrumental analysis, McGraw Hill Publication
- Clark and Swizer, Experimental Biochemistry, Freeman, 2000
- Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
- Recommended readings.
- Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
- Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
- Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge. Practical
- Swarup N, Arora S and Pathak SC, Laboratory Techniques in Modern Biology. Kalyani Publishers
- Sharma B.K., Principles of Instrumentation Goel Publishing House
- Upadhayay Upadhayay & Nath, Principles of Instrumentation, Himalaya Publishing House
- Chatwal G R & Anand Sharma , Principles of Instrumental method of Chemical Analysis, Himalaya Publishing House
- Arumugam N, Kumaresan V, Biotechniques Saras Publication
- Ghatak K L, Techniques and Methods in Biology PHI Learning

Online Resources–

- **https://www.youtube.com/watch?v= t9Zh3PJaF4**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSC-08P**		
2	**Course Title**	**Biotechniques**		
3	**Course Type**	**Discipline Specific Lab Course**		
4	**Pre-requisite** (if, any)	***As Per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand the purpose of the technique, its proper use and possible modifications/improvement. ➢ Developed skills in handling instruments. ➢ Developed skills in the performance of experiments through scientific planning. ➢ Develop critical thinking on reviewing, discussing and reporting the results. ➢ Applied and Correlate the knowledge for better development of society.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**List of labs to be conducted** • Study and handling of Compound Microscope, pH meter, Colorimeter, Centrifuge, Spectrophotometer, Chromatography Chamber, Electrophorosis Unit, Microtome. • Sterilization of Lab equipments. • Determination of pH of different soil samples & water samples. • Determination of maximum absorption. • Separation of Amino acids, plant pigment and sugar by paper and thin layer chromatography • Separation of DNA and RNA through Paper & Gel Electrophoresis • Separation of particles by Centrifuge. • Preparation of Permanent slides through Microtome. • Preparation of Temporary and Permanente slides of some microscopic organisms. • Pure culture of cell. • Cell fractionation • Contour drawing through Camera Lusida • Preparation of Practical Record. • Group discussion/Viva or Seminar presentation on above mentioned and related topics.	**30**
Keywords	*Centrifuge, Spectrophotometer, Chromatography Chamber, Electrophorosis Unit, Microtome, Cell fractionation, Camera Lusida.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sharma B.K., Principles of Instrumentation-
- Upadhayay Upadhayay & Nath, Principles of Instrumentation, Himalaya Publishing House
- Chatwal G R & Anand Sharma , Principles of Instrumental method of Chemical Analysis, Himalaya Publishing House

Reference Books Recommended –

- Boyer, R. (2000) Modern Experimental Biochemistry (3rd edition) Benjamin-Cummings.
- Recommended readings.
- Pearse, A.G.E. (1980-1993) Histochemistry - Theoretical and applied, Volume I-III, Churchill-Livingstones.
- Plummer, D. (2017) An Introduction to Practical Biochemistry (3 rd edition) McGraw Hill.
- Wilson, K. and Walker, J. (2010) Experimental Biochemistry, Cambridge. Practical
- Swarup N, Arora S and Pathak SC, Laboratory Techniques in Modern Biology. Kalyani Publishers
- Robert Braun, Introduction to Instrumental analysis

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/gb9ai2ctttc**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE- 09T**		
2	**Course Title**	**Basics of Computer and Biostatistics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to:** ➢ Understand the computer, its applications and use in biostatistics. ➢ Understand collection of biological data and analysis of the data. ➢ Learn about how the statistical data present. ➢ Developed critical thinking to analyze and represent the significance of the statistical data. ➢ Apply the knowledge in future for Research.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Unit-I: Computer structure and Applications:** History of Computers, Structure of Computers, Classification of Computers, Introduction to digital computer- basic knowledge of hardware & software, CPU, Input and Output devices, Computer Codes: Decimal System, Binary number system, hexadecimal system, octal system, conversion of numbers. Introduction to MS Office- MS Word, MS Excel, MS Power point, Introduction of Internet, web-mail, various search engine, Plagiarism, Artificial Intelligence (AI).	12
II	**Unit-II: Data collection, presentation, and Measures of central tendency:** Collection and classification of data. Presentation of data: by Tables - rules for making tables, use of tables, Types of tables, By Graphs: rules for making graph & it's uses, Pie chart, Bar diagram, Histogram, Frequency polygon, Cumulative frequency curve (Ogive and Polygon). Measures of central tendency: Arithmetic Mean, Median, Mode.	11
III	**Dispersion Correlation and Regression:** Measures of dispersion: Standard deviation and Standard error. Correlation: Types, significance and application of correlation, calculation of correlation in continuous data and ordinal data. Regression: Linear regression, regression coefficient.	11
IV	**Probability and Analysis of Significant Test:** Probability: normal, binomial distribution and Poisson distributions. Hypothesis testing, Test of significance: Paired and unpaired t-test and Chi square test. Analysis of Variance (one & two way ANOVA).	11
Keywords	*Computer, MS Word, MS Excel, MS Power point, web-mail, central tendency, ANOVA, Hypothesis testing*	

Signature of Convener & Members (CBoS):

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Balagurusamy, E. (2011) Fundamentals of Computers, McGraw Hill Education, Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
- Sinha, P., Sinha, P.K. (2004), Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB Publications.
- Khanal, A.B. (2015), Mahajan's Methods in Biostatistics, The Health Sciences Publishers,

Reference Books Recommended –

- Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences(10th edition) John Wiley.
- Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and HealthSciences (2nd edition) McGraw Hill.
- Zar, JH, (2010), Biostatistical Analysis, Prentice-Hall/Pearson, 2010.

Online Resources–

National Digital Library

- **https://drive.google.com/file/d/1EaBH4SfE4AcdmoDzQ7iFwMSJkmSfIQet/view**
- **http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/swayam_ugc_moocs/IN_S_U_M_1_P_C_3_B_a_M_B_233_234?e=2|biostatistics|||**
- **http://ndl.iitkgp.ac.in/he_document/bharat_skills/bharat_skills/01_2434?e=0|basic%20computer|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-09P**		
2	**Course Title**	**Basics of Computer and Biostatistics**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing lab course the students will be able to** ➢ Understand the computer, its applications and use in biostatistics practically. ➢ Understand and learn collection of biological data and analyzes them. ➢ Learn to present and interpret the analyzed data. ➢ Developed critical thinking to assess the significance of the statistical data and discuss the result. ➢ Apply the knowledge in future for Research.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**List of labs to be conducted** ➢ Exercise based on Microsoft word. ➢ Study of hardware & software. ➢ PPT Slide preparation using Microsoft Power Point. ➢ Data collection. ➢ Analyzing Data manually and through computer: Mean, Median, Mode, SD, SE, Correlation and regression and its interpretation. ➢ Tabular & Graphical presentation of data manually and using excel. ➢ Hypothesis testing by *t*-test, Chi-square test and ANOVA. ➢ Group discussion/Quiz/Seminar presentation on related topics. ➢ Practical Record or Lab assignment.	**30**
Keywords	*Graphical presentation, hardware & software, Microsoft Power Point, Microsoft word.*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Balagurusamy, E. (2011) Fundamentals of Computers, McGraw Hill Education, Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
- Sinha, P., Sinha, P.K. (2004), Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB Publications.
- Khanal, A.B. (2015), Mahajan's Methods in Biostatistics, The Health Sciences Publishers,

Reference Books Recommended –

- Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences(10th edition) John Wiley.
- Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and HealthSciences (2nd edition) McGraw Hill.
- Zar, JH, (2010), Biostatistical Analysis, Prentice-Hall/Pearson, 2010.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/libretexts/libretexts/ee0516013368a11b75812bda4e208fc6?e=0|MEAN%20MODE%20MEADIAN|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE- 10T**		
2	**Course Title**	**Behaviour and Chronobiology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Learn a wide range of theoretical knowledge about the animal behavior. ➢ Develop skills, to understand the responses of animal according to stimuli. ➢ Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives. ➢ Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild. ➢ Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**		**Min Passing Marks: 40**

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Behaviour and the response invoking stimuli:** Animal behavior: Scope and importance of study. Ethology: history & branches. Ethogram: analysis of behavior. Causation of Behaviour: Proximate and ultimate causes of behavior. Stimulus: Definition, Types of stimuli invoking response: internal and external. Patterns of behaviour: Foraging behaviour, Aggressive behavior, Territorial behaviour. Allelomimetic behavior. Stereotyped Behaviors: Taxis and Reflexes: Taxis: Phototaxis, Geotaxis, Thermotaxis, Thigmotaxis, Galvanotaxis, Chemotaxis and Rheotaxis, Klinotaxis and Telotaxis. Reflexes: Definition, Kinds- Localized, Tonic & Phasic, Types of reflex action unconditioned reflexes and Conditioned reflexes	12
II	**Innate and Learning Behavior: Innate or Instinct Behaviour:** Fixed action Pattern: Definition and Characteristics: Constancy, Resistance to Phylogenetic Changes, Concept of Sign, Innate Releasing Mechanism (IRM) and Action Specific Energy (ASE). Bird migration, Navigation and Orientation. Learning Behavior: Classical conditioning (Pavlov Experiment), Types of Conditioning: Forward, Backward, Simultaneous and Temporal conditioning. Properties of Conditioning: Generalization, Discrimination, Extinction, Recovery from Extinction, Acquisition, Reinforce, Positive and Negative conditioning. Habituation. Instrumental learning / trial and error. Imprinting: types of imprinting: filial and sexual. Reasoning and Insight learning. Neural mechanism of learning.	11
III	**Social behavior and Evolutionary aspects of Behavior:** Social organization in honey bee & Primates. Elements of Socio-biology: Eusociality, Selfishness, cooperation, altruism, kinship, reciprocation and inclusive fitness. Communication: chemical, visual, light, tactile and audio. Evolutionary aspects of behavior: feeding strategies, Mimicry and Colouration, Evolution of reproductive behavior: Theory of Sexual Selection, secondary sex characteristics, Parental care in Fish and Amphibia.	11
IV	**Chronobiology:** Biological Rhythm: Types of biological rhythm: Ultradian, Circadian and Infradian. Characteristics of rhythm: mesor, amplitude, acrophase, period and phase. Patterns of biological rhythm: Exogenous and Endogenous rhythm; Entrained and Free run rhythm. Advantages of biological rhythms. Biological clock: components of clock, functions of biological clock. Applications of chronobiology.	11
Keywords	*Ethogram, Mimicry, Reflexes, biological rhythm, Parental care, Imprinting, Biological clock*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Reena Mathur (2021) Animal Behaviour, 6th Edition, Rastogi Publication.
- Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer -Verlag, Germany.

Reference Books Recommended –

- McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited,London, UK.
- Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6thedition) Cambridge, University Press, UK
- Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
- Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition)Sinauer Associate Inc., Massachusetts, USA.
- Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology BiologicalTimekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

Online Resources–

- **https://g.co/kgs/TGgyveE**
- **https://www.researchgate.net/profile/Atanu-Pati/publication/278157972_Chronobiology_The_Dimension_of_Time_in_Biology_and_Medicine/links/557c8b1208aec87640db4e73/Chronobiology-The-Dimension-of-Time-in-Biology-and-Medicine.pdf**
- **https://jmpas.com/admin/assets/article_issue/1643653535JMPAS_JANUARY_-_FEBRUARY_2022.pdf**
- **https://www.amazon.in/Concise-Book-Animal-Behaviour-Chronobiology/dp/819580571X**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-10P**		
2	**Course Title**	**Behaviour and Chronobiology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Learn a wide range of practical knowledge about the animal behavior. ➢ Develop skills, to understand the response of animals according to stimuli in lab. ➢ Objectively understand and evaluate information about animal behaviour and learn to form the ethogram. ➢ Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the surroundings. ➢ Consider and evaluate behaviour of animals, including Human in the nature.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	➢ Orientation of an animal in response to stimulus: To study geotaxis in earthworm and phototaxis in insect larvae. ➢ Constructing an Ethogram. ➢ Demonstration of learning behaviour in wasps to locate their burrow by using landmarks. ➢ Chemical communication in ants. ➢ Study of selective predation of coloured prey items through video/charts. ➢ Predatory behaviour of a carnivorous animal. ➢ Nests and nesting habits of the birds and social insects. ➢ Study the behavioural responses of wood lice to dry and humid conditions. ➢ Study of mimic animals in nature and take photographs. ➢ Study of circadian functions in humans (daily eating, sleep and temperature patterns). ➢ Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report. ➢ Group discussion or Seminar presentation on related topics. ➢ An "Animal album or Practical Record" containing sketches, photographs, cut outs, with appropriate write up about the above mentioned behavioural patterns.	**30**
Keywords	*Phototaxis, geotaxis, Predatory behavior, wood lice, circadian functions, temperature pattern, ethogram*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Reena Mathur (2021) Animal Behaviour, 6th Edition, Rastogi Publication.
- Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer - Verlag, Germany.

Refernce *Books Recommended –*

- McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited,London, UK.
- Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6thedition) Cambridge, University Press, UK
- Alcock, J. (2005) Animal Behaviour (8th edition) Sinauer Associate Inc., USA.
- Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition)Sinauer Associate Inc., Massachusetts, USA.
- Dunlap, J. C.; Loros, J.J. and DeCoursey, P. J. (2009) Chronobiology BiologicalTimekeeping (1st edition) Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/1fvtujeiyjw?e=0|*|||**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/7j0mtol4jrc?e=11|*|||**

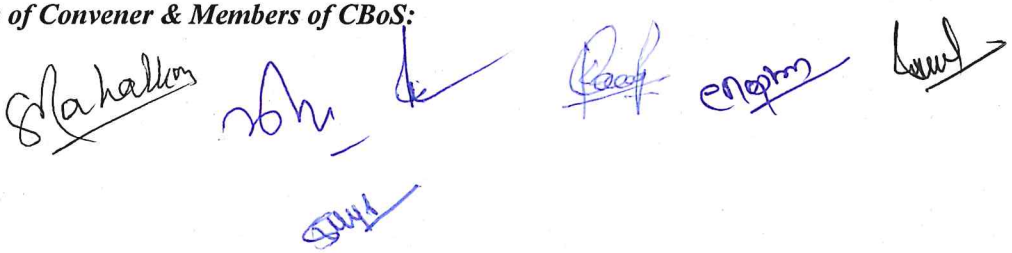
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	**Course Code**	**ZOSE-11T**		
2	**Course Title**	**Developmental Biology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if, any)**	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Understand of the fundamental processes involved in embryonic development, including cell differentiation, morphogenesis, and patterning ➢ Explain mechanisms underlying developmental processes, ➢ Learn reproductive techniques commonly used in developmental biology ➢ Aware of current trends and advances in developmental biology research, including emerging technologies. ➢ Understand the relevance of developmental biology in medicine or its role in development of diseases.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Gametes Biology:** Biology of sex determination and differentiation, Origin of primordial germ cells. Morphology of different types of gametes: Male gamete and female gamete. Formation of Gametes: Process of Spermatogenesis, Biochemical changes in spermatogenesis and control of spermatogenesis, Semination. Process of Oogenesis, Biochemical changes in Oogenesis and control of Oogenesis, Vitellogenesis: Structure and composition of yolk. Ovulation and ovum transport in mammals. Infertility in Male and female: Causes and Cure. Fertilization: external and internal fertilization, Recognition of gametes, capacitation, acrosome reaction, activation of egg metabolism, migration of pronuclei, amphimixis and post fertilization changes in the egg cytoplasm. Block to polyspermy. Parthenogenesis.	11
II	**Embryology:** Cleavage: pattern and mechanism of cleavage, physiology of cleavage. Mosaic and regulative development, Direct and indirect development, Body plan and symmetries. Germ layer differentiation. Tubulation. Morphogenesis: Epiboly, E mboly/invagination, involution and ingression. Fate maps: Methods of construction of fate map, fate map of Amphioxus, Amphibians and Chick. Formative movements, Metamorphosis: In Insect and in frog. Hormonal regulation of metamorphosis. Cell signaling, cell adhesion during tissue organization,lateral inhibition, induction, and recruitment. Organogenesis: formation of gut, heart, kidney and muscles, molecular mechanism involved. Pleuropotency.	11
III	**Developmental Biology: Organizer concept:** Types, characteristics & mechanism of organizer. Extra embryonic membranes: Development and functions in chick. Axis Formation in Drosophila, Metamorphosis in insect and in Frog. Hormonal regulation of metamorphosis. Placenta: Structure, functions and its types. Regeneration: Types- epimorphosis, morphollaxis and compensatory regeneration, mechanisms and physiological processes involved in regeneration, ability of regeneration in invertebrates and vertebrates, difference between embryogenesis and regeneration and tissue repair. Concept of competence, determination and differentiation and growth. Ageing and apoptosis.	11
IV	**Reproductive Technology and Reproductive Health: *In vitro* fertilization:** Artificial insemination (AI); Gamete intra-fallopian transfer (GIFT), Intra-cytoplasmic sperm injection (ICSI), Zygote Intra Fallopian Transfer (ZIFT), Test tube baby. Causes of Infertility. Multiple ovulation and embryo transfer technology (IVF and IVET), Pre implantation genetic diagnosis (PGD). Ethics in surrogacy. Teratology & teratogens: wound healing, birth defects, developmental brain disorders. Neuro degeneration. Endocrine Disruptors & Cancer. Causes of Sexually transmitted diseases: HIV/AIDS & Human Papilloma virus (HPV), Syphilis. Menstrual Disorders, Polycystic Ovarian Disease & Polycystic Ovarian Syndrome (PCOD & PCOS).	12
Keywords	*Spermatogenesis, Oogenesis, Gametes, Fertilization, Development, Cleavage, Fate maps, Organizers, Teratology*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Agrawal V K, Evolution and Developmental Biology, S Chand Publication
- Verma P S, Agrawal V K, Chordate Embryology, S Chand Publication
- Arumugam N, Embryology , Saras Publication
- Shasrti K V, Shukla Vinita, Developmental Biology, Rastogi Publication

Reference Books Recommended –

- Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
- Gilbert, S.F. (2010) Developmental Biology (9th edition). Sinauer
- Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press

Online Resources–

- **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==**
- **http://ndl.iitkgp.ac.in/he_document/aklectures/aklectures/4_3_2_1638?e=15|*|||**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/cnqxwmzey1w?e=1|*|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** **+20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-11P**		
2	**Course Title**	**Developmental Biology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Acquire knowledge of the fundamental processes involved in embryonic development, Types of eggs ➢ Explain developmental processes and identify various stages of development through study of permanent slides , ➢ Learn experimental techniques commonly used in developmental biology ➢ Aware of current trends and advances in developmental biology research, including emerging technologies.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Types of eggs based on quantity and distribution of yolk: sea urchin, insect frog, Chick. ➢ Comparative study of cleavage patterns in Frog and Amphioxus models. ➢ Study of cell movement, shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick through models and charts. ➢ Study of whole mounts and sections of developmental stages of frog through permanent slides: blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages) ➢ Study of whole mounts of developmental stages of chick through permanent slides -18 hours, 24 hours, 33 hours, 48 hours, 72 hours and 96 hours of incubation ➢ Extra embryonic membranes of chick through models and charts. ➢ In vivo study of chick embryo development by windowing and candling methods. (Demonstration only) ➢ Some videos to develop understanding on the process of development. ➢ Group Discussion / Quiz /Seminar / Project related topics ➢ Prepare practical record	**30**
Keywords	*Types of eggs, Cleavage, frog, Chick Embryology, Chick Embryo Development Windowing*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- ***Lal S S, Vertebrate Practical***
- ***Phukan LunaDevelopmental Biology Practical, Mahaveer Publication***

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/pttau909f8a?e=0|living%20chick%20embryos%20%E2%80%93%20observations|||**
- **https://egyankosh.ac.in/bitstream/123456789/16460/1/Unit-26.pdf**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-12T**		
2	**Course Title**	**Molecular Biology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario. ➢ Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields. ➢ Apply their knowledge in problem solving and future course of their career development in higher education and research. ➢ Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Chromosomes and Nucleic Acids:** Chromosomes structure: Chromatin (Euchromatin and heterochromatin), Types of chromosomes. Histones, Histone-modifications. Structure of Nuclic acids: Structure and functions of DNA, DNA forms: Plasmid DNA, Genomic DNA and Repetitive DNA. DNA polymorphisms. DNA modifications. Structure and Function of RNA: Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA. RNA Induced Silencing Complex and CRISPR Technology. Mutation: Chromosomal and gene mutation.	11
II	**Central dogma and DNA replication:** Central dogma of Molecular Biology. DNA methylation. DNA-Protein interaction. DNA Replication, plasmid DNA replication and genomic DNA replication, Centromeric and Telomeric DNA replication, DNA replication and cell cycle regulation. DNA polymerases. DNA-damaging agents. DNA repairing.	11
III	**Transcription:** Concept of Transcription, RNA polymerase I, II, III, transcription factors. RNA processing, splicing of hnRNA into mRNA, 5'-capping and 3'-polyadenylation of mRNA, rRNA and tRNA modifications and processing. RNA editing, alternative splicing, trans- splicing, miRNA, siRNA, piRNA, lncRNA, RNA-protein complex.	11
IV	**Translation:** Structure of Ribosomes, Genetic Code, triplet codons, Wobble base, synonymous codons, degeneracy of codon. Translation in prokaryotic and Eukaryotic cells (Aminoacylation of tRNA, initiation, elongation, peptide bond formation, translocation, termination, recycling of ribosome). Post-translational modifications and processing of proteins, large protein-protein complexes and protein trafficking Reregulation of protein synthesis in prokaryotic and eukaryotic cell.	12
Keywords	*Chromosomes, Nucleic Acids, CRISPR, tRNA, Transcription, Translation, Central dogma*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Chaudhari K, Molecular Biology Text book IFAS Publication
- Verma P.S., Agrawal V.K., Molecular Biology S Chand

Reference Books Recommended –

- Watson, J.D. *et al.* (2013) Molecular Biology of the Gene (7th edition) CSHL Press Pearson.
- Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.
- Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
- Cell Biology by De Roberties
- Gene by Lewine 7th to 11th edition

Online Resources–

- https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Cell_Molecular_Biology,
- https://www.tezu.ernet.in/Library/index.php/e-journals/55-microbiology-and-molecular-biology-education-oa

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20** +**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with research)*			**Semester VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-12P**		
2	**Course Title**	**Molecular Biology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Mastery of fundamental laboratory techniques used in molecular biology, such as DNA extraction, PCR (Polymerase Chain Reaction), gel electrophoresis, DNA sequencing, and cloning. ➢ Ability to design experiments, including selecting appropriate methodologies, controls, and troubleshooting potential issues that may arise during experiments. ➢ Proficiency in analyzing experimental data, including interpreting ➢ Development of critical thinking skills to evaluate experimental results.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	➢ Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs). ➢ Preparation of RNA model for tRNA, mRNA and rRNA molecule (A=U and G=C base pairs) ➢ Preparation of Central dogma model with reference to Replication, Transcription and Translation i.e., Linear flow of genetic information. ➢ Isolation of genomic DNA by ethanol precipitation method. ➢ Preparation of model pBR322 ➢ Agarose gel electrophoresis of the plasmid DNA and the genomic DNA. ➢ Chromosomal staining ➢ Temporary slide preparation of Salivary gland chromosome from drosophila larva. ➢ Group discussion/Quiz/Seminar presentation on related topics. ➢ Practical Record or Lab assignment.	**30**
Keywords	*Molecular Biology, DNA model, Central Dogma, Agrose Gel electrophoresis, chromosome, salivary gland chromosomes of Drosophila*	
Signature of Convener & Members (CBoS) :		

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Sarma. PVGK, Molecular Biology Practical Mannual, MJP Publisher
- Pranav Kumar, Fundamentals and Techniques of Biophysics and Molecular Biology, Pathfinder Publication

Reference Books Recommended

- Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/IN_I e P P 1 Z 512 96 P 1 M c b 51376 51377?e=16|*|||**
- **http://ndl.iitkgp.ac.in/he_document/swayam_prabha/ke040dcj_84**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS: