

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

<b>PART- A: Introduction</b>			
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)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ Master mechanisms, kinetics, mechanism and reactivity factors in organic chemistry.</li> <li>➤ Understand and predict regioselectivity in aromatic electrophilic substitution reactions.</li> <li>➤ Utilize symmetry and group theory to analyze molecules and predict spectroscopic features.</li> <li>➤ Understand and classify supramolecular chemistry</li> </ul>	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)	No. of Period	
I	<b>MECHANISTIC ORGANIC CHEMISTRY</b> 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, Vilsmeier-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe-Schmitt reaction	12	
II	<b>SUBSTITUTION REACTIONS</b> 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 regioselectivity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by $\pi$ and $\sigma$ 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	

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	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	<b>Symmetry and Group Theory in Chemistry</b> 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	<b>Supramolecular Chemistry:</b> 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. <b>Transport processes and carrier design.</b> Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry. <b>Metal Clusters:</b> Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds. <b>Isopoly and Heteropoly Acids and Salts.</b>	11
Keywords	<i>Reaction mechanisms, kinetics, regioselectivity, electrophilic substitution, substitution mechanisms, neighboring group participation, symmetry, group theory, supramolecular chemistry</i>	

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-**

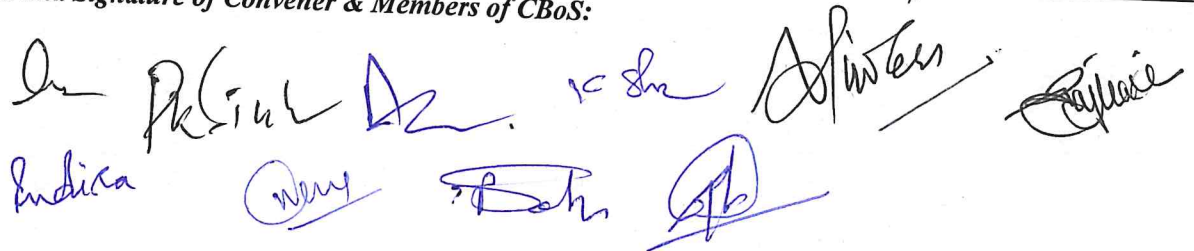
- [https://onlinecourses.nptel.ac.in/noc20\\_cy30/preview](https://onlinecourses.nptel.ac.in/noc20_cy30/preview)
- <https://swayam.gov.in/>
- <https://www.coursera.org/>
- <https://www.edx.org/>
- [https://onlinecourses.nptel.ac.in/noc20\\_cy30/preview](https://onlinecourses.nptel.ac.in/noc20_cy30/preview)

### PART -D: Assessment and Evaluation

Dr. Pratul K. Singh  
 Indira Behl  
 Dr. K. S. M. D. S. S.  
 Dr. S. S. S. S.  
 Dr. S. S. S. S.  
 Dr. S. S. S. S.

<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	<b>100 Marks</b>	
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>	
<b>End Semester Exam (ESE):</b>	<b>70 Marks</b>	
<b>Continuous Internal Assessment (CIA): (By Course Teacher)</b>	Internal Test / Quiz-(2): <b>20 +20</b> Assignment / Seminar - <b>10</b> Total Marks - <b>30</b>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</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:*


  
 Indira      (Name)      B. S.      P. B.      P. S.      P. S.      P. S.

# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

## DEPARTMENT OF CHEMISTRY

### COURSE CURRICULUM

<b>PART- A: Introduction</b>			
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)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.</li> <li>➤ To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.</li> <li>➤ To learn about separation and purification of organic mixtures by chromatography</li> <li>➤ To identify and characterize prepared and separated compounds by IR spectral analysis.</li> </ul>	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
<b>PART -B: Content of the Course</b>			
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	<b>Organic Synthesis</b> <ul style="list-style-type: none"> <li>(i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.</li> <li>(ii) Synthesis of <math>\beta</math>-Naphthyl acetate / Hydroquinone diacetate.</li> <li>(iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol</li> <li>(iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid</li> <li>(v) Aldol condensation: Dibenzalacetone from benzaldehyde</li> <li>(vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o-chlorobenzoic acid from anthranilic acid.</li> <li>(vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.</li> <li>(viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol.</li> <li>(ix) Friedel Crafts Reaction: <math>\beta</math>-Benzoyl propionic acid from succinic anhydride and benzene.</li> <li>(x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline.</li> <li>(xi) Clemmenson reduction: Hydrocarbons from ketones.</li> <li>(xii) Nitration: Picric acid from phenol</li> <li>(xiii) Reduction: Acetic acid from ethanol.</li> <li>(xiv) Esterification: Oil of Wintergreen from salicylic acid.</li> <li>(xv) Sulphonation: Sulphanilic acid from aniline.</li> </ul> <p><b>Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.</b>                      Identification of functional group of organic compounds by FTIR                      Separation, purification and identification of compounds of binary mixtures TLC</p>		<b>30</b>

	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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment	Managed by Course teacher as per lab. status
	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	

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

<b>PART- A: Introduction</b>			
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.O utcomes(CLO)	<ul style="list-style-type: none"> <li>➤ To acquire the knowledge of surface tension</li> <li>➤ To apply the principle of conductance in studying different applications.</li> <li>➤ To apply various concepts of Physical Chemistry and use instruments in studying various applications.</li> <li>➤ To acquire the surface tension – concentration relationship for solution</li> </ul>	
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)

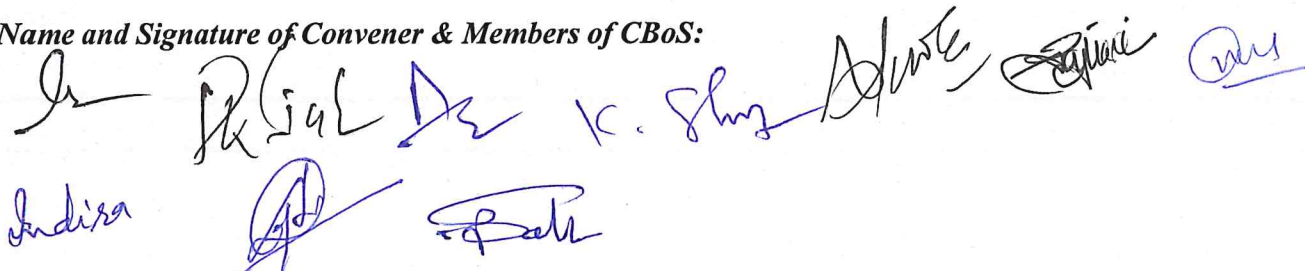
Module	Topics(Coursecontents)	No.of Period
Lab./Field Training/ Experiment Contents of Course	<p><b>Conductometry</b>            Estimation of aspirin from tablet.            Determination of relative strengths of different acids.            Determination of the strength of strong and weak acids in a given mixture conductometrically.</p> <p><b>Potentiometry/pH metry</b>            Determination of temperature dependence of EMF of a cell.            To determine <math>pK_a</math> of the given monobasic acid by pH metric titration.            Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.</p> <p><b>Surface Tension:</b>            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.</p>	30
Keywords	Conductometry, potentiometry, pH-metry, CMC	

Signature of Convener & Members (CBoS):

<b>PART-C</b>
<b>Learning Resources: Text Books, Reference Books and Others</b>
<b>Textbook Recommended</b> 1. Athawale, V. D., & Oza, N. R. (2001). <i>Experimental physical chemistry</i> . New Age International Publishers.
<b>Online Resources-</b> ➤ SWAYAM <a href="https://swayam.gov.in">https://swayam.gov.in</a> ➤ e-Pathshala <a href="https://epathshala.nic.in">https://epathshala.nic.in</a>

<b>Part-D: Assessment and Evaluation</b>		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>		<b>50 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>		<b>15 Marks</b>
<b>End Semester Exam (ESE):</b>		<b>35 Marks</b>
<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	Better marks out of two Test/Quiz + obtained marks in assessment shall be considered against 15 Marks
<b>End Semester Exam (ESE):</b>	<b>Laboratory/Field Skill Performance : on spot Assessment</b> 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	<b>Managed by Course teacher as per Lab. Status.</b>

**Name and Signature of Convener & Members of CBoS:**


  
 Indira

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

<b>PART-A: Introduction</b>			
<b>Program: Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester-VIII</b>	<b>Session: 2024-25</b>
1	Course Code	CHSE-09T	
2	Course Title	APPLICATION OF SPECTROSCOPY -II	
3	Course Type	DSE	
4	Pre-requisite(if,any)	<i>As per Program</i>	
5	Course Learning Outcomes(CLO)	<ul style="list-style-type: none"> <li>➤ <i>To interpret the vibrational spectra of molecules to identify functional groups and understand their bonding modes.</i></li> <li>➤ <i>To gain proficiency in analyzing NMR and ESR spectra to determine the structure and electronic environment of atoms within a molecule.</i></li> <li>➤ <i>To equip students with the ability to utilize Mössbauer spectroscopy for the characterization of iron-containing materials, analyzing their oxidation state and local environment.</i></li> <li>➤ <i>To develop the skills to interpret mass spectra, including fragmentation patterns, to determine the molecular weight and structure of unknown compounds.</i></li> </ul>	
6	Credit Value	03Credit	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	TotalMarks	Max.Marks:100	MinPassingMarks:40
<b>PART-B: Content of the Course</b>			
Total No.ofTeaching-learningPeriods (01Hr.perperiod)			
Module /Unit	Topics(Coursecontents)	No.of Period	
I	<b>Vibrational Spectroscopy</b> 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. <b>Optical Rotatory Dispersion (ORD)and Circular Dichroism (CD)</b> Definition, deduction of absolute configuration, Octant rule for Ketone	12	
II	<b>Nuclear Magnetic Resonance Spectroscopy</b> 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. <b>Carbon-13 NMR Spectroscopy</b> General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic,	11	

	heteroaromatic and carbonyl carbon), coupling constants. <b>Two-dimension NMR Spectroscopy:</b> COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techniques.	
III	<b>Electron Spin Resonance Spectroscopy</b> 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). <b>Mossbauer Spectroscopy</b> Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe <sup>+2</sup> and Fe <sup>+3</sup> compounds including those of intermediate spin, (2) Sn <sup>+2</sup> and Sn <sup>+4</sup> compounds - nature of M - L bond coordination number, structure and (3) Detection of oxidation state and inequivalent M atoms.	11
IV	<b>Mass Spectrometry</b> 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, McLafferty rearrangement. Nitrogen rule. High-resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	11
Keywords	<i>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</i>	

Signature of Convener & Members (CBoS):

<b>PART-C</b>	
<b>Learning Resources: Textbooks, Reference Books and Others</b>	
<b>Textbooks Recommended</b>	
<ol style="list-style-type: none"> <li>1. Chatwal, G. R., &amp; Sharma, A. (2017). <i>Instrumental Methods of Chemical Analysis</i>. Himalaya Publishing House.</li> <li>2. Sharma, Y. R. (2000). <i>Infrared Spectroscopy: Fundamentals and Applications</i>. Alpha Science Agency.</li> <li>3. Aruldas, B. R. (2007). <i>Nuclear Magnetic Resonance Spectroscopy</i>. Springer.</li> </ol>	
<b>Reference Books Recommended</b>	
<ol style="list-style-type: none"> <li>1. Nakamoto, K. (2009). <i>Infrared and Raman Spectra: Inorg. and coordination compounds</i>. Wiley.</li> <li>2. Parish, R. V., &amp; Ellis, H. A. (1978). <i>NMR, NQR, EPR and Mossbauer Spectroscopy</i>. in <i>Inorg. Chem.</i> Ellis Horwood.</li> <li>3. Martin, M. L., Delpeuch, J. J., &amp; Martin, G. J. (1982). <i>Practical NMR Spectroscopy</i>. Heyden.</li> <li>4. Silverstein, R. M., Bassler, G. C., &amp; Morrill, T. C. (1991). <i>Spec. Identification of Org. Compd.</i> John Wiley.</li> <li>5. Abraham, R. J., Fisher, J., &amp; Loftus, P. (2011). <i>Introduction to NMR Spectroscopy</i>. Wiley.</li> <li>6. Dyer, J. R. (1978). <i>Application of Spectroscopy of Organic compounds</i>. Prentice Hall.</li> <li>7. Williams, D. H., &amp; Fleming, I. (1990). <i>Spectroscopic Methods in Org. Chem.</i> Tata McGraw Hill.</li> </ol>	
<b>Online Resources – e-Resources/e-books and e-learning portals</b>	
<ul style="list-style-type: none"> <li>• <a href="https://swayam.gov.in/nd1_noc19_ch08/preview">https://swayam.gov.in/nd1_noc19_ch08/preview</a></li> <li>• <a href="https://www.coursera.org/learn/spectroscopy-chemistry">https://www.coursera.org/learn/spectroscopy-chemistry</a></li> <li>• <a href="https://nptel.ac.in/courses/104/106/104106050/">https://nptel.ac.in/courses/104/106/104106050/</a></li> <li>• <a href="https://epathshala.nic.in/e-textbook/Class%20XI/Chemistry/ChemistryIEng.pdf">https://epathshala.nic.in/e-textbook/Class%20XI/Chemistry/ChemistryIEng.pdf</a></li> </ul>	

Indira, K. Singh, K. Sharma, Anshu, and others.

**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**

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

*Name and Signature of Convener and Members of CBoS*

*Is* *Pr Singh D* *10. Singh* *Shweta* *Shweta*  
*Indira* *(Signature)* *(Signature)* *(Signature)*

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

<b>PART-A: Introduction</b>			
<b>Program: Bachelors in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester-VIII</b>	Session: 2024-25
1	Course Code	CHSE-09P	
2	Course Title	SPECTROSCOPY-II LAB. COURSE	
3	Course Type	DSE	
4	Pre-requisite(if,any)	<i>As per Program</i>	
5	Course Learning Outcomes(CLO)	<ul style="list-style-type: none"> <li>➤ <i>Understand working principle of FTIR instrument and interpret FTIR spectrum.</i></li> <li>➤ <i>Interpretation of H- NMR spectra, Carbon-13 NMR and ESR spectra and identifying molecules based on chemical shifts and coupling constants.</i></li> <li>➤ <i>Interpretation of Mossbauer spectra and understanding its working principle.</i></li> <li>➤ <i>Understanding working principle of mass spectrometry and interpret mass spectrum.</i></li> </ul>	
6	Credit Value	01Credit	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max.Marks:50	MinPassingMarks:20
<b>PART-B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
Module	Topics(Course contents)		No. of Period
Lab./Field Training/ Experiment Contents of Course.	<b>FTIR</b> <ul style="list-style-type: none"> <li>• To prepare the KBr pellet of an organic compound (such as benzoic acid).</li> <li>• To carry out a qualitative analysis of an organic compound (such as benzoic acid) using FTIR.</li> <li>• To identify IR absorption peaks and the corresponding functional groups of an unknown solid/liquid/powder.</li> <li>• To study the Optical Rotatory Dispersion (ORD) of some chiral substances.</li> </ul>		30
	<b>NMR and <sup>13</sup>CNMR</b> <ul style="list-style-type: none"> <li>• To interpret the peaks and identify molecules/structures of NMR spectrums.</li> <li>• To interpret the peaks and identify molecule(s)/structures of <sup>13</sup>CNMR spectrums.</li> <li>• To interpret the peaks and identify molecules/structures based on both NMR and <sup>13</sup>CNMR spectrums.</li> </ul>		
	<b>ESR and Mossbauer</b> <ul style="list-style-type: none"> <li>• To interpret the peaks and identify the magnetic character of metal/ion based on ESR spectroscopy.</li> <li>• To determine the resonance magnetic field B<sub>0</sub> as function of the selected resonance frequency (ν) and the g-factor of DPPH.</li> <li>• To determine the line width δB<sub>0</sub> of the resonance signal.</li> <li>• To interpret and understand the Mössbauer spectra of iron Fe and Sn complexes.</li> <li>• To interpret the peaks (signals) and identify metal/ions based on ESR and</li> </ul>		



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

<b>PART-A: Introduction</b>			
<b>Program: Bachelors in Science</b> <i>(Certificate/Diploma /Degree/Honors)</i>		<b>Semester–VIII</b>	
		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)	<ul style="list-style-type: none"> <li>➤ Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.</li> <li>➤ Apply the concept of band theory to explain the behavior of conductors.</li> <li>➤ To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles</li> <li>➤ To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.</li> </ul>	
6	CreditValue	03Credits	Credit = 15 Hours - learning & Observation
7	TotalMarks	Max.Marks:100	MinPassingMarks:40
<b>PART-B: Content of the Course</b>			
TotalNo.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics(Course contents)		No.of Period
I	<b>Crystal Defects and Non-Stoichiometry</b> 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. <b>Organic Solids</b> Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.		12
II	<b>Electronic Properties and Band theory</b> 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	<b>Introduction to Nano-materials</b> 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 nanoparticles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and micro-		11

	emulsion methods.	
<b>IV</b>	<b>Characterization of nano-materials</b> 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/Differential Thermal Analyzer (TG/DTA) <b>Applications of Nanomaterials:</b> Applications of nano in biology, nanoprobes for analytical applications, status of nanobiotechnology, future perspectives of nanobiology; nanosensors.	<b>11</b>
<b>Keywords</b>	<b>Nanomaterials, synthesis, characterization, applications, SEM, TEM, IR, UV-visible, TGA, DTA, nanosensors, nanotechnology.</b>	

**Signature of Convener & Members (CBoS):**

<b>PART-C</b>	
<b>Learning Resources: Text books, Reference Books and Others</b>	
<b>Textbooks Recommended-</b>	
<ol style="list-style-type: none"> <li>1. Keer, H. V. (1993). <i>Principles Of The Solid State</i>. New Age International.</li> <li>2. Rao, C. N. R., Müller, A., &amp; Cheetham, A. K. (Eds.). (2006). <i>The Chemistry Of Nanomaterials: Synthesis, Properties and Applications</i>. John Wiley &amp; Sons.</li> <li>3. Kulkarni, S. K., &amp; Kulkarni, S. K. (2015). <i>Synthesis Of Nanomaterials—II (Chemical Methods)</i>. <i>Nanotechnology: Principles And Practices</i>, 77-109.</li> </ol>	
<b>Reference Books Recommended-</b>	
<ol style="list-style-type: none"> <li>1. Hannay, N. B. (1973). <i>Solid state chemistry</i>. In <i>Electronic Materials</i> (pp. 505-534). Boston, MA: Springer US.</li> </ol>	
<b>Online Resources-e-Resources/e-books and e-learning portals</b>	
<ul style="list-style-type: none"> <li>• <a href="https://web.mit.edu/robertsilbey/research/papers/1981-1990/rsilbey_structure_properties_organic_solid_state.pdf">https://web.mit.edu/robertsilbey/research/papers/1981-1990/rsilbey_structure_properties_organic_solid_state.pdf</a></li> <li>• <a href="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://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</a></li> <li>• <a href="https://jiwaji.edu/pdf/ecourse/chemistry/Electronic%20Properties%20and%20Band%20Theory.pdf">https://jiwaji.edu/pdf/ecourse/chemistry/Electronic%20Properties%20and%20Band%20Theory.pdf</a></li> <li>• <a href="https://www.researchgate.net/publication/259118068_Chapter_-_INTRODUCTION_TO_NANOMATER">https://www.researchgate.net/publication/259118068_Chapter_-_INTRODUCTION_TO_NANOMATER</a></li> </ul>	

<b>PART -D: Assessment and Evaluation</b>		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>		<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>		<b>30 Marks</b>
<b>End Semester Exam (ESE):</b>		<b>70 Marks</b>
<b>Continuous Internal Assessment (CIA): (By Course Teacher)</b>	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
<b>End Semester Exam (ESE):</b>	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., 1 out of 2 from each unit-4x10=40 Marks	

**Name and Signature of Convener and Members of CBoS**

Indira, [Signature], [Signature], [Signature], [Signature], [Signature]

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

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester - VIII</b>	<b>Session: 2024-25</b>
1	Course Code	CHSE-11T	
2	Course Title	NATURAL PRODUCTS & MEDICINAL CHEMISTRY	
3	Course Type	DSE	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ <i>To study the occurrence, types, structure, and analysis methods of terpenes and alkaloids and their biosynthesis</i></li> <li>➤ <i>To grasp key concepts in medicinal chemistry and drug terminology and learn importance of drug structure for activity.</i></li> <li>➤ <i>To explore specific drug classes and study the medicinal value of natural products</i></li> </ul>	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<b>Natural Products- Class, Structure and biological importance</b> 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 $\alpha$ -pinene).		12
II	<b>Alkaloids and Biosynthesis</b> 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	<b>Introduction to Medicines</b> 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, Quantitative-structure activity relationships (QSAR), binding role of -OH group, -NH <sub>2</sub> group, double bond, and aromatic ring.		11
IV	<b>Pharmaceutical Compounds</b> 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).
<b>Keywords</b>	<b>Natural Products, Structure Elucidation, Terpenes &amp; Alkaloids, Medicinal Chemistry, Drug Discovery, Structure-Activity Relationships (SAR), Pharmacokinetics &amp; Pharmacodynamics, Drug Targets, Pharmaceutical Compounds</b>

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://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

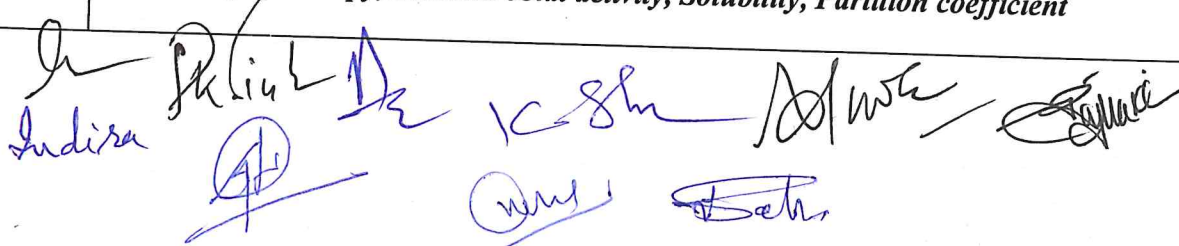
<b>Continuous Internal Assessment (CIA): (By Course Teacher)</b>	Internal Test / Quiz-(2): 20 / 20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
<b>End Semester Exam (ESE):</b>	Two section – A & 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:

Indira  
K. S. Shy  
Anita  
Rajni

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

<b>PART- A: Introduction</b>			
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-8)	
3	Course Type	DSE	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ <i>Demonstrate competence in determining the physicochemical properties of drugs relevant to their biological activity.</i></li> <li>➤ <i>Gain practical experience in the synthesis and characterization of common drugs.</i></li> <li>➤ <i>Develop skills in isolating natural products from plant sources and analyzing their purity.</i></li> <li>➤ <i>Evaluate the antimicrobial potential of natural product extracts or synthetic drugs.</i></li> <li>➤ <i>Integrate theoretical concepts of medicinal chemistry with laboratory techniques.</i></li> </ul>	
6	Credit Value	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
<b>PART -B: Content of the Course</b>			
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 <sub>a</sub> 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. <b>Antimicrobial Activity Assay:</b> 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		<b>30</b>
Keywords	<i>Physicochemical properties, Drug synthesis, Drug characterization, Natural product isolation, Spectroscopy, Antimicrobial activity, Solubility, Partition coefficient</i>		


  
 Indira, [Signature], [Signature], [Signature], [Signature], [Signature], [Signature]

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.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%3AKaulzarich/Text/04.\\_Infrared\\_Spectroscopy/4.2%3A\\_IR\\_Spectroscopy\\_Analysis](https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_124A%3AKaulzarich/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](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	Better marks out of the two Test / Quiz  + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance - 05 Total Marks - 15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment	Managed by Course teacher as per lab. status
	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	

Name and Signature of Convener & Members of CBoS:

Indira

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

<b>PART-A: Introduction</b>			
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	Course Learning Outcomes(CLO)	<ul style="list-style-type: none"> <li>➤ Understand the importance of sampling and sample treatment.</li> <li>➤ Select appropriate sampling technique based on sample and target analyte.</li> <li>➤ Explain principle and instrumentation involved in AAS.</li> <li>➤ Deduce the necessity to remove interferences in AAS and methods involved.</li> <li>➤ Select proper technique among the available techniques.</li> <li>➤ Formulate experiments based on optical and electroanalytical techniques.</li> </ul>	
6	Credit Value	03Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max.Marks:100	MinPassingMarks:40
<b>PART-B: Content of the Course</b>			
<b>Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)</b>			
Module /Unit	Topics(Course contents)		No. of Period
I	<b>Sampling and sample treatment:</b> 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	<b>Polarography and amperometry</b> 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



- <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://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](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:

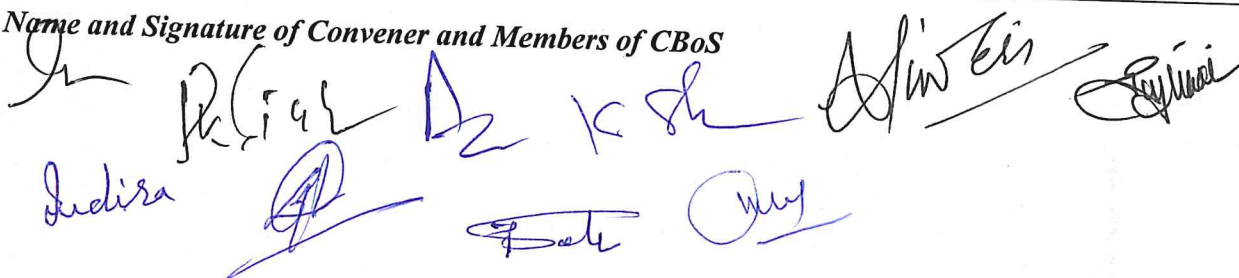
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 <del>20</del>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
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


  
 Indira

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

<b>PART-A: Introduction</b>			
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-	
3	Course Type	DSE	
4	Pre-requisite (if, any)	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ Understanding fundamental principles of polarography and amperometry.</li> <li>➤ Understand the working principle of UV-visible and Atomic absorption spectroscopy.</li> <li>➤ Handling and working with Fluorometer, understanding fluorescence quenching.</li> <li>➤ Handling of flame photometer instrument.</li> <li>➤ To determine concentration of ions in different samples by Nephelo-Turbidometry.</li> </ul>	
6	Credit Value	01Credit	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
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.	<b>Polarography and Amperometry:</b> <ul style="list-style-type: none"> <li>• Determination of half wave potential <math>E_{1/2}</math> and unknown concentration of Cu or Pb or Zn ion.</li> <li>• Amperometric titration of <math>Pb(NO_3)_2</math> with <math>K_2Cr_2O_7</math>.</li> </ul>	30
	<b>Absorption spectroscopy:</b> 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	
	<ul style="list-style-type: none"> <li>• Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds.</li> <li>• To determine <math>\lambda_{max}</math> of phenol and effects of solvents on absorption spectra of phenol.</li> <li>• Assay of paracetamol by UV- Spectrophotometry</li> <li>• To determine the amount of Ca in a sample using the standard calibration curve- Atomic Absorption Spectroscopy (AAS).</li> </ul>	
	<b>Fluorimetry and Flame Photometry:</b> <ul style="list-style-type: none"> <li>• To perform the assay of Riboflavin tablets by fluorimetry</li> <li>• Estimation of quinine sulfate by fluorimetry</li> <li>• Study of quenching of fluorescence</li> <li>• To study the effect of concentration in fluorescence intensity of quinine</li> </ul>	

	<p>sulphate solution.</p> <ul style="list-style-type: none"> <li>To determination concentration of sodium in given unknown sample by Flame photometry</li> <li>To determination concentration of potassium in given unknown sample by Flame photometry</li> </ul>
	<p><b>Nephelometry and turbidimetry:</b></p> <ul style="list-style-type: none"> <li>To determine phosphate ion concentration in water sample by Nephelo-Turbidometry.</li> <li>To determine sulphate and/or chloride ion concentration in water sample by Nephelo-Turbidometry.</li> </ul>
Keywords	<i>Polarography, Amperometry, Absorption Spectroscopy, Fluorimetry, Flame Photometry, Nephelometry, Turbidimetry, Fluorescence, Lambda Max, Absorbance, concentration.</i>

Signature of Convener & Members (CBoS) :

<b>PART-C,</b>								
<b>Learning Resources: TextBooks, Reference Books and Others</b>								
<b>Textbooks Recommended-</b>								
<ol style="list-style-type: none"> <li>Sharma, B. K. (1981). <i>Instrumental methods of chemical analysis</i>. Krishna Prakashan Media.</li> <li>Badwaik, H. R., Thote L.K.; Giri, T.K. (2022). <i>Practical Handbook: Instrumental methods of analysis</i>. Vallabh Prakashan. Delhi, India.</li> <li>Sethi, P. D. (1985). <i>Quantitative analysis of drugs in pharmaceutical formulations</i>. Unique Publishers.</li> </ol>								
<b>Reference Books Recommended-</b>								
<ol style="list-style-type: none"> <li>Vogel, A. I., &amp; Jeffery, G. H. (1989). <i>Vogel's textbook of quantitative chemical analysis</i>. (No Title).</li> <li>Stenlake, J. B. (1976). <i>Practical pharmaceutical chemistry</i>. Athlone Press.</li> </ol>								
<b>OnlineResources- e-Resources/e-booksand-learningportals</b>								
<ul style="list-style-type: none"> <li><a href="https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf">https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf</a></li> <li><a href="https://mlrip.ac.in/wp-content/uploads/2022/03/INSTRUMENTAL-METHODS-OF-ANALYSIS-LAB-MANUAL.pdf">https://mlrip.ac.in/wp-content/uploads/2022/03/INSTRUMENTAL-METHODS-OF-ANALYSIS-LAB-MANUAL.pdf</a></li> <li><a href="https://www.studyandscore.com/studymaterial-detail/flame-photometer-principle-components-working-procedure-applications-advantages-and-disadvantages">https://www.studyandscore.com/studymaterial-detail/flame-photometer-principle-components-working-procedure-applications-advantages-and-disadvantages</a></li> <li><a href="https://www.youtube.com/watch?v=DFQd0Ncj76w">https://www.youtube.com/watch?v=DFQd0Ncj76w</a></li> <li><a href="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.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</a></li> <li><a href="https://www.scribd.com/document/434710621/EXP-4-AAS">https://www.scribd.com/document/434710621/EXP-4-AAS</a></li> </ul>								
<b>PART -D: Assessment and Evaluation</b>								
<b>Suggested Continuous Evaluation Methods:</b>								
Maximum Marks: 100 Marks								
Continuous Internal Assessment (CIA): 30 Marks								
End Semester Exam (ESE): 70 Marks								
<b>Continuous Internal Assessment (CIA): (By Course Teacher)</b>	<table border="1"> <tr> <td>Internal Test / Quiz-(2):</td> <td>20 <del>20</del></td> </tr> <tr> <td>Assignment / Seminar -</td> <td>10</td> </tr> <tr> <td>Total Marks -</td> <td>30</td> </tr> </table>	Internal Test / Quiz-(2):	20 <del>20</del>	Assignment / Seminar -	10	Total Marks -	30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
Internal Test / Quiz-(2):	20 <del>20</del>							
Assignment / Seminar -	10							
Total Marks -	30							
<b>End Semester Exam (ESE):</b>	<p>Two section – A &amp; B</p> <p>Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks</p> <p>Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks</p>							

Name and Signature of Convener & Members of CBoS:

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

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Sciences</b> (Honors)		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	Course Code	<b>BOSC –VIII T</b>	
2	Course Title	<b>Molecular biology and Biostatistics</b>	
3	Course Type	<b>Discipline Specific course (DSC)</b>	
4	Pre-requisite (if, any)	<i>As per program</i>	
5	Course Learning Outcomes (CLO)	<ul style="list-style-type: none"> <li>➤ Students should know about cellular and gene regulation to understand genomic functions</li> <li>➤ Understand the concept of ‘one gene one enzyme hypothesis’ along with the molecular mechanism of mutation</li> <li>➤ Students will be familiar with the genetic material DNA structure its role and defects and repairing</li> <li>➤ Students will be familiar with the RNA structure its role</li> <li>➤ Students will be familiar with data handling.</li> </ul>	
6	Credit Value	<b>3 Credits</b>	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
<b>I</b>	<b>Nucleic acids:</b> 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.		<b>12</b>
<b>II</b>	<b>Mutation and DNA repair</b> 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		<b>11</b>
<b>III</b>	<b>Protein synthesis and gene regulation</b> 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.		<b>11</b>
<b>IV</b>	<b>Biostatistics :</b> Graph, central tendency (Mean, median and mode) Standard Deviation, Standard error Chi square test, regression, degree of freedom		<b>11</b>
Keywords	<i>DNA, RNA, protein synthesis, gene regulation, central tendency</i>		
<b>Signature of Convener &amp; Members (CBoS) :</b>			

1. *R. Kumar*
2. *Kumar*
3. *Indira*
4. *M. S.*
5. *H.*

6. *Deep*
7. *Shanti*
8. *Meera*
9. *H.*
10. *Deep*

## 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](http://www.swayam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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.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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	
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:

① R. Roy  
② Anand  
③ Anshu  
④ M. Anshu  
⑤ Anshu  
⑥ Anshu  
⑦ Anshu  
⑧ Anshu  
⑨ Anshu  
⑩ Anshu

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Sciences (Honors)</b>		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>BOSC -08</b>	
2	<b>Course Title</b>	<b>Lab. Course-08 (Molecular biology and Biostatistics)</b>	
3	<b>Course Type</b>	<b>Laboratory course</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per program</b>	
5	<b>Course Learning Outcomes (CLO)</b>	After the completion of the course the students will be able to: <ul style="list-style-type: none"> <li>➤ Isolate DNA from plant cell and <i>E.Coli</i>.</li> <li>➤ Learn chimera formation in various plants.</li> <li>➤ Understand the functioning and application of spectrophotometer.</li> <li>➤ Understand the interpretation of data with the help of statistical data.</li> </ul>	
6	<b>Credit Value</b>	<b>1 Credits</b>	<b>Credit =30 Hours Laboratory or Field learning/Training</b>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 20</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
Module	Topics (Course contents)		No. of Period
<b>Lab./Field Training/ Experiment Contents of Course</b>	<ul style="list-style-type: none"> <li>➤ Isolation of DNA from plant cells.</li> <li>➤ Quantitative measurement of DNA by Spectrophotometric method.</li> <li>➤ Feulgen or hydrolytic staining of DNA.</li> <li>➤ Chimera formation in Bougainvillea and other ornamental and other different plants.</li> <li>➤ Isolation of plasmid DNA from <i>E. coli</i>.</li> <li>➤ Isolation of <i>Rhizobium</i> from root nodules of leguminous plants.</li> <li>➤ Isolation of <i>Agrobacterium tumifaciens</i> from tumours of dicot plants.</li> <li>➤ Preparation of LB medium and raising <i>E. Coli</i>.</li> <li>➤ DNA estimation by diphenylamine reagent/UV Spectrophotometry.</li> <li>➤ Analysis of statistical data: Statistical tables, Central tendency - mean mode, median, standard deviation and standard error (using seedling population /leaflet size etc).</li> <li>➤ Calculation of correlation coefficient values and finding out the probability.</li> <li>➤ Computer application in biostatistics - MS Excel and SPSS</li> </ul>		<b>30</b>
<b>Keywords</b>	<b>Spectrophotometer, Plasmid, colchicine, E.Coli, Central tendencies.</b>		
<b>Signature of Convener &amp; Members (CBoS) :</b>			

① R. Divya  
 ② Leena  
 ③ Neelima  
 ④ M. ...

⑤ [Signature]  
 ⑥ [Signature]  
 ⑦ [Signature]  
 ⑧ Amey  
 ⑨ [Signature]  
 ⑩ [Signature]

## 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. Freeman 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](http://www.swayam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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.k-state.edu/wgrc/electronic_lab/feul_stain_prot.html)
- [https://www.westga.edu/academics/research/vrc/assets/docs/spss\\_basics.pdf](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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
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:

① Shriya  
 ② Nanda  
 ③ Mallikarjuna  
 ④ [Signature]  
 ⑤ [Signature]  
 ⑥ [Signature]  
 ⑦ [Signature]  
 ⑧ [Signature]  
 ⑨ [Signature]  
 ⑩ [Signature]

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honors)</b>		<b>Semester -VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>BOSE -09 T</b>	
2	<b>Course Title</b>	<b>Plant Biotechnology and Crop Improvement</b>	
3	<b>Course Type</b>	<b>Discipline specific Elective (DSE)</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per program</b>	
5	<b>Course Learning Outcomes (CLO)</b>	<input type="checkbox"/> At the end of this course, the students will be able to <ul style="list-style-type: none"> <li>➤ The basic concept, scope and significance of Biotechnology.</li> <li>➤ Micropropagation using meristem and shoot culture to produce large number of identical individuals.</li> <li>➤ The role of biotechnology in crop improvement.</li> <li>➤ Various applications of Biotechnology in different fields.</li> </ul>	
6	<b>Credit Value</b>	<b>3 Credits</b>	<b>Credit = 15 Hours - learning &amp; Observation</b>
7	<b>Total Marks</b>	<b>Max. Marks: 100</b>	<b>Min Passing Marks: 40</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)</b>			
<b>Unit</b>	<b>Topics (Course contents)</b>		<b>No. of Period</b>
<b>I</b>	<b>Fundamentals of Biotechnology:</b> Basic concepts, principles and scope. <b>Plant Cell and Tissue Culture:</b> General concept, history, scope, totipotency, concept of cellular differentiation, tissue culture media and explants. Applications of Plant Biotechnology.		<b>12</b>
<b>II</b>	<b>Organogenesis and Embryogenesis:</b> 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.		<b>11</b>
<b>III</b>	<b>Somatic Hybridization:</b> Concept of somatic fusion and hybridization; Protoplast isolation, fusion and culture, hybrid selection and regeneration; progress, possibilities, achievements and limitations of protoplast research.		<b>11</b>
<b>IV</b>	<b>Application of Plant Tissue Culture in crop improvement:</b> 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.		<b>11 (11Hr)</b>
<b>Keywords</b>	Biotechnology, Tissue Culture, Crop improvement, Clonal propagation		

**Signature of Convener & Members (CBoS) :**

① R. D. Saha  
 ② K. S. Choudhary  
 ③ [Signature]  
 ④ [Signature]

⑦ [Signature]  
 ⑧ [Signature]  
 ⑨ [Signature]  
 ⑩ [Signature]

⑤ [Signature]  
 ⑥ [Signature]

## 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. .Kantha, 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](http://www.swayam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
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:

① P. P. P. P.  
② P. P. P. P.  
③ P. P. P. P.  
④ P. P. P. P.  
⑤ P. P. P. P.  
⑥ P. P. P. P.

⑦ P. P. P. P.  
⑧ P. P. P. P.  
⑨ P. P. P. P.  
⑩ P. P. P. P.

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honors)</b>		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>BOSE-09 P</b>	
2	<b>Course Title</b>	<b>Lab. Course -09 (Plant biotechnology and crop improvement)</b>	
3	<b>Course Type</b>	<b>Laboratory course</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per program</b>	
5	<b>Course Learning Outcomes (CLO)</b>	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	<b>Credit Value</b>	<b>1 Credits</b>	<b>Credit =30 Hours Laboratory or Field learning/Training</b>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 20</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
<b>Module</b>	<b>Topics (Course contents)</b>		<b>No. of Period</b>
<b>Lab./Field Training/ Experiment Contents of Course</b>	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.		<b>30</b>
<b>Keywords</b>	Medium, protoplast, tissue culture, TZ		

**Signature of Convener & Members (CBoS) :**

① <i>R. Singh</i>	⑦ <i>Sudhin</i>
② <i>Samudra</i>	⑧ <i>Aniraj</i>
③ <i>M</i>	⑨ <i>H</i>
④ <i>[Signature]</i>	⑩ <i>[Signature]</i>
⑤ <i>[Signature]</i>	
⑥ <i>[Signature]</i>	

## 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%20commericalization.>
- <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](http://www.swayam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egvankosh.ac.in](http://www.egvankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	

End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment	Managed by Course teacher as per lab. status
	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	

Name and Signature of Convener & Members of CBoS:

① P. Sivas  
② P. Sivas  
③ M. Sivas  
④ S. Sivas  
⑤ S. Sivas  
⑥ S. Sivas

⑦ S. Sivas  
⑧ S. Sivas  
⑨ S. Sivas  
⑩ S. Sivas

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
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: <ul style="list-style-type: none"> <li>➤ Understand the scope and importance of Social forestry and establishment of orchard.</li> <li>➤ Learn silvics of some important timber plants of India.</li> <li>➤ Learn post-harvest management, marketing and value addition of commercial ornamental plants.</li> <li>➤ Develop a deep understanding of different forms of intellectual property Rights (IPR)</li> </ul>	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<b>Social forestry:</b> 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 <b>Layout and Establishment of Orchards:</b> Pruning and training; propagation, Climatic requirement and cultivation of fruits like Mango, Banana, Citrus, Guava.		12
II	<b>Silviculture:</b> 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. Silvics of important forest tree species e.g. Teak, Shorea, Sheesam.		11
III	<b>Floriculture;</b> 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	<b>IPR:</b> Definition and significance of intellectual property rights (IPR), Overview of different types of IPR, including patents and its filing process, copyrights, trademarks their registration and infringement, trade secrets, Historical development and international frame works for protecting IPR, Salient feature of Patent Act 1970.		11
<b>Keywords</b> Social forestry, Orchard, Harvesting technique, Trademark			

**Signature of Convener & Members (CBOS) :**

① <i>R. Bose</i>	⑦ <i>Shelina</i>
② <i>Deved</i>	⑧ <i>Amity</i>
③ <i>...</i>	⑨ <i>...</i>
④ <i>...</i>	⑩ <i>...</i>
⑤ <i>...</i>	
⑥ <i>...</i>	

## 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](http://www.ipindia.gov.in)

[www.wipo.int/aboutip/en/](http://www.wipo.int/aboutip/en/)

[www.india.gov.in /topics/agriculture/floriculture](http://www.india.gov.in/topics/agriculture/floriculture)

[https://byjus.com/free-ias-prep/ipr-in-india-upsc notes/](https://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](http://www.swayam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	

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
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### Name and Signature of Convener & Members of CBoS:

① R.P. Singh  
② S. S. Negi  
③ M. S. Negi  
④ S. S. Negi  
⑤ S. S. Negi  
⑥ S. S. Negi

⑦ S. S. Negi  
⑧ S. S. Negi  
⑨ S. S. Negi  
⑩ S. S. Negi

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honors)</b>		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>BOSE-10 P</b>	
2	<b>Course Title</b>	<b>Lab. Course -10 (Applied Botany and Intellectual Property Rights)</b>	
3	<b>Course Type</b>	<b>Laboratory course</b>	
4	<b>Pre-requisite (if, any)</b>	<i>As per program</i>	
5	<b>Course Learning Outcomes (CLO)</b>	At the end of this course, students will be able to: <ul style="list-style-type: none"> <li>➤ Understand forest structure and composition.</li> <li>➤ Get knowledge about phenology of various species.</li> <li>➤ Learn nursery bed preparation technique.</li> <li>➤ Analyze the density and moisture content of wood.</li> </ul>	
6	<b>Credit Value</b>	<b>1 Credits</b>	<b>Credit =30 Hours Laboratory or Field learning/Training</b>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 20</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
<b>Module</b>	<b>Topics (Course contents)</b>		<b>No. of Period</b>
<b>Lab./Field Training/ Experiment Contents of Course</b>	<ul style="list-style-type: none"> <li>• Study of forest composition.</li> <li>• Recording the observations on phenological characteristics of different tree species.</li> <li>• Study of the natural and artificial regeneration.</li> <li>• Lay outting of nursery bed and soil preparation, types of seed sowing in nursery bed.</li> <li>• Study of gross features of different types of wood; straight interlocked, spiral and wavy grain, texture, lusture, etc.</li> <li>• Study of characteristics of trees/shrubs/grasses for agroforestry.</li> <li>• Volume and biomass estimation.</li> <li>• Crown measurement.</li> <li>• Study of vase life extension in cut flower using chemicals.</li> <li>• Study and description of botanical features of floricultural plants studied in theory paper.</li> <li>• Drafting a patent application: Students can learn how to draft a patent application for a new invention .</li> <li>• Trademark registration process: Students can learn how to register a trademark in India.</li> </ul>		<b>30</b>
<b>Keywords</b>	<i>Phenological, Wood grain, Nursery bed, Regeneration</i>		

**Signature of Convener & Members (CBoS) :**

① R. Pooja  
 ② Renuka  
 ③ M. S. Srinivas  
 ④ *[Signature]*  
 ⑤ *[Signature]*  
 ⑥ *[Signature]*  
 ⑦ *[Signature]*  
 ⑧ *[Signature]*  
 ⑨ *[Signature]*  
 ⑩ *[Signature]*

## 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 Gupur 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=tYvsC0dwtU0>
- [https://www.youtube.com/watch?v=U5\\_nynPVdTY](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=uDWiLCvc3IQ>

#### Online Resources–

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

- > [www.swayam.ac.in](http://www.swayam.ac.in)
- > [www.ignou.ac.in](http://www.ignou.ac.in)
- > [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- > [www.iitm.ac.in](http://www.iitm.ac.in)
- > [www.eskillindia.org](http://www.eskillindia.org)
- > [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- > [www.vlab.co.in](http://www.vlab.co.in)
- > [www.internshala.com](http://www.internshala.com)
- > [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar +Attendance - 05 Total Marks - 15	
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:

① *Rajiv*  
 ② *Arundh*  
 ③ *[Signature]*  
 ④ *[Signature]*  
 ⑤ *[Signature]*  
 ⑥ *[Signature]*  
 ⑦ *[Signature]*  
 ⑧ *[Signature]*

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honors)</b>		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>BOSE -11 T</b>	
2	<b>Course Title</b>	<b>Biochemistry and Enzymology</b>	
3	<b>Course Type</b>	<b>Discipline specific Elective (DSE)</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per program</b>	
5	<b>Course Learning Outcomes (CLO)</b>	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	<b>Credit Value</b>	<b>3 Credits</b>	<b>Credit = 15 Hours - learning &amp; Observation</b>
7	<b>Total Marks</b>	<b>Max. Marks: 100</b>	<b>Min Passing Marks: 40</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)</b>			
<b>Unit</b>	<b>Topics (Course contents)</b>		<b>No. of Period</b>
<b>I</b>	<ul style="list-style-type: none"> <li>• Structure of atoms, molecules and chemical bonds.</li> <li>• Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).</li> <li>• Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties)..</li> <li>• Composition, structure and function of biomolecules (carbohydrates,).</li> </ul>		<b>12</b>
<b>II</b>	<ul style="list-style-type: none"> <li>• Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.</li> <li>• Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and function of ATP.</li> </ul>		<b>11</b>
<b>III</b>	<ul style="list-style-type: none"> <li>• Lipids : structure and function, alpha and beta oxidation and anabolism.</li> <li>• Nucleic acids : DNA, RNA, Conformation of nucleic acids (helix (A, B,C, Z), t-RNA, mRNA, rRNA, HnRNA micro-RNA).hoogestein bridge, hairpin DNA</li> </ul>		<b>11</b>
<b>IV</b>	<ul style="list-style-type: none"> <li>• Proteins- amino acids, primary, secondary, tertiary and quaternary structure. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).</li> <li>• 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.</li> </ul>		<b>11</b>
<b>Keywords</b> reaction kinetics, inhibition. active sites, Conformation, ATP			

**Signature of Convener & Members (CBoS) :**

Biophysical chemistry  
 Bioenergetics  
 Lipids  
 Nucleic acid  
 Protein  
 Enzymology

① P. Roy  
 ② K. Mandal  
 ③ M. Saha  
 ④ S. Ghosh  
 ⑤ S. Ghosh  
 ⑥ S. Ghosh  
 ⑦ S. Ghosh  
 ⑧ S. Ghosh  
 ⑨ S. Ghosh  
 ⑩ S. Ghosh

## 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 Verlag, 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. Sinauer Associates, Inc. Publishers, Massachusetts, 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%20control%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](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](http://www.swayam.ac.in)
- > [www.ignou.ac.in](http://www.ignou.ac.in)
- > [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- > [www.iitm.ac.in](http://www.iitm.ac.in)
- > [www.eskillindia.org](http://www.eskillindia.org)
- > [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- > [www.vlab.co.in](http://www.vlab.co.in)
- > [www.internshala.com](http://www.internshala.com)
- > [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
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:

① R. P. Das  
② M. S. D. S.  
③ K. S.  
④ K. S.  
⑤ K. S.  
⑥ K. S.

⑦ S. S. S.  
⑧ S. S. S.  
⑨ S. S. S.  
⑩ S. S. S.

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honors)</b>		<b>Semester -VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	BOSE -11 P	
2	<b>Course Title</b>	Lab. Course -11 P (Biochemistry and enzymology)	
3	<b>Course Type</b>	Laboratory course	
4	<b>Pre-requisite (if, any)</b>	As per program	
5	<b>Course Learning Outcomes (CLO)</b>	<ul style="list-style-type: none"> <li>➤ Students will be familiar with the common biobuilding block</li> <li>➤ Biochemical analysis of common biomolecules</li> <li>➤ Enzyme kinetics and its role</li> <li>➤ Characterization of light harvesting molecule chlorophyll.</li> </ul>	
6	<b>Credit Value</b>	1 Credits	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 20</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
Module	Topics (Course contents)		No. of Period
Lab./Field Training/Experiment Contents of Course	<ol style="list-style-type: none"> <li>1) Biochemical test of carbohydrates, sucrose, glucose proteins, lipids</li> <li>2) Biochemical test of Catalase, dehydrogenase, peroxidase test</li> <li>3) Preparation of chlorophyll extract</li> <li>4) Separation of chlorophyll by paper chromatography.</li> <li>5) Separation of chlorophyll amino acids by paper chromatography.</li> <li>6) Effect of temperature on enzyme activity</li> <li>7) Effect of pH on enzyme activity</li> </ol>		<b>30</b>
<b>Keywords</b>	Biochemical test, Catalase, dehydrogenase, chlorophyll, enzyme		
<b>Signature of Convener &amp; Members (CBoS) :</b>			

① R. Singh  
 ② Kundu  
 ③ M. S. Singh  
 ④ Singh  
 ⑤ Singh  
 ⑥ Singh

⑦ Singh  
 ⑧ Singh  
 ⑨ Singh  
 ⑩ Singh

## 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 2001 by S.K. Sawhney (Editor), R. Singh (Editor) Narosa Publishing House
2. Practical Enzymology Author(s): Prof. Dr. Hans Bisswanger First published: 23 February 2011 Print 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](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](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](http://www.swayam.ac.in)
- > [www.ignou.ac.in](http://www.ignou.ac.in)
- > [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- > [www.iitm.ac.in](http://www.iitm.ac.in)
- > [www.eskillindia.org](http://www.eskillindia.org)
- > [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- > [www.vlab.co.in](http://www.vlab.co.in)
- > [www.internshala.com](http://www.internshala.com)
- > [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance - 05 Total Marks - 15	
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:

① *Ramesh*  
② *Ramesh*  
③ *M*

④ *Ramesh*  
⑤ *Ramesh*  
⑥ *Ramesh*

⑦ *Mullin*  
⑧ *Das*  
⑨ *S*  
⑩ *Uday*

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honors)</b>		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	Course Code	BOSE- 12 T	<i>Genetic</i>
2	Course Title	Bioinformatics and Gené 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
<b>PART -B: Content of the Course</b>			
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<b>Introduction to Bioinformatics:</b> 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	<b>Applications of Bioinformatics :</b> 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	<b>Genetic technology :</b> 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	<b>Application of genetic technology:</b> Genetically modified organism; bt cotton and btbrinjal.Transgenic crop; Golden rice. <i>Agrobacterium</i> transformation,Hybridomaand monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy, social, legal and ethical aspect of cloning.		11
<b>Keywords</b> Bioinformatics, Durg design, Crop improvement, ELISA			

**Signature of Convener & Members (CBoS) :**

① <i>R. S. Bose</i>	⑥ <i>Blank</i>
② <i>Handa</i>	⑦ <i>Indira</i>
③ <i>M. S.</i>	⑧ <i>Prity</i>
④ <i>...</i>	⑨ <i>H.</i>
⑤ <i>...</i>	⑩ <i>...</i>

## 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 Ouellette, 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.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.swavam.ac.in](http://www.swavam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
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:

① *R.P. Rao*  
② *Sharma*  
③ *M.*

④ *[Signature]*  
⑤ *[Signature]*  
⑥ *[Signature]*

⑦ *[Signature]*  
⑧ *[Signature]*  
⑨ *[Signature]*  
⑩ *[Signature]*

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF BOTANY**

**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program: Bachelor in Life Science (Honours)</b>		<b>Semester - VIII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>BOSE -12 P</b>	
2	<b>Course Title</b>	<b>Lab. Course -12 (Bioinformatics and Gene Technology)</b>	
3	<b>Course Type</b>	<b>Laboratory course</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per program</b>	
5	<b>Course Learning Outcomes (CLO)</b>	At the end of this course, students will be able to: <ul style="list-style-type: none"> <li>➤ Retrieve gene and protein from gene bank.</li> <li>➤ Understand steps of production of GMO.</li> <li>➤ Learn the isolation of plasmid DNA.</li> <li>➤ Understand use and application of PCR.</li> </ul>	
6	<b>Credit Value</b>	<b>1 Credits</b>	<b>Credit =30 Hours Laboratory or Field learning/Training</b>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 20</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
<b>Module</b>	<b>Topics (Course contents)</b>		<b>No. of Period</b>
<b>Lab./Field Training/ Experiment Contents of Course</b>	<ul style="list-style-type: none"> <li>• Retrieve the gene from Gene bank and to save the sequence in FASTA format.</li> <li>• Retrieve the protein from Gene bank and to save the sequence in FASTA format.</li> <li>• Find the similarity of sequence for the given nucleotide or protein sequence.</li> <li>• Find the similarity of sequence for the given protein sequence.</li> <li>• Study of steps of genetic engineering for production of Bt cotton, Golden rice through photographs.</li> <li>• Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, micro projectile, bombardment.</li> <li>• Isolation of plasmid DNA.</li> <li>• Restriction digestion and gel electrophoresis of plasmid DNA.</li> <li>• Demonstration of PCR.</li> </ul>		<b>30</b>
<b>Keywords</b>	<b>Gene bank , FASTA, Agrobacterium, PCR</b>		

**Signature of Convener & Members (CBoS) :**

① ② ③ ④ ⑤ ⑥	⑦ ⑧ ⑨ ⑩
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## 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 Ouellette, 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 Organisms Transgenesis 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://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://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\\_Electrophoresis](https://bio.libretexts.org/Bookshelves/Biotechnology/Lab_Manual%3A_Introduction_to_Biotechnology/01%3A_Techniques/1.12%3A_Restriction_Digest_with_Gel_Electrophoresis)
- <https://www.youtube.com/watch?v=matsiHSuoOw>

#### Online Resources–

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

- [www.swayam.ac.in](http://www.swayam.ac.in)
- [www.ignou.ac.in](http://www.ignou.ac.in)
- [www.egyankosh.ac.in](http://www.egyankosh.ac.in)
- [www.iitm.ac.in](http://www.iitm.ac.in)
- [www.eskillindia.org](http://www.eskillindia.org)
- [www.eshiksha.mp.gov.in](http://www.eshiksha.mp.gov.in)
- [www.vlab.co.in](http://www.vlab.co.in)
- [www.internshala.com](http://www.internshala.com)
- [www.ndl.iitkgp.ac.in](http://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	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance - 05	
	Total Marks - 15	

End Semester Exam (ESE): 35	Laboratory / Field Skill Performance: On spot Assessment	Managed by Course teacher as per lab. status
	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	

Name and Signature of Convener & Members of CBos:

① Rajeev  
② Mund  
③ As  
K. V.

④ As  
⑤ As

⑦ As  
⑧ As  
⑨ As  
⑩ As

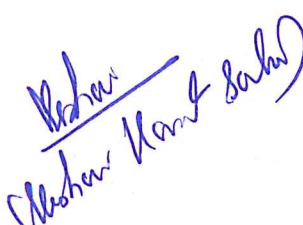
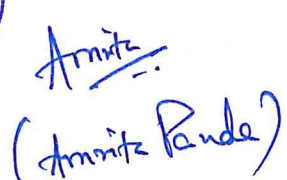
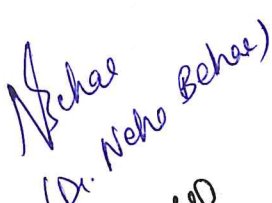
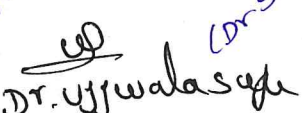
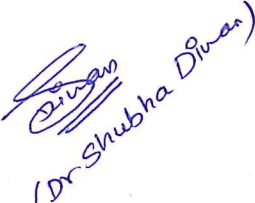

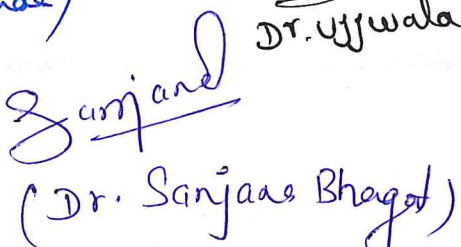
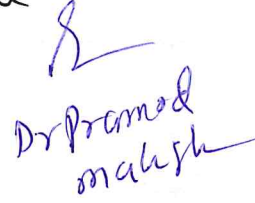
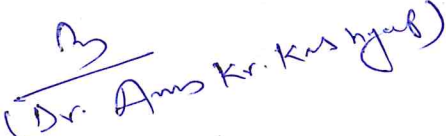
**Four Year Undergraduate Program (2024-28)**  
**Department of Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem      Session: 2024-2025
1	Course Code	<b>BTSC-08-T</b>
2	Course Title	<b>Biostatistics and Bioinformatics</b>
3	Course Type	Discipline Specific Course (DSC)
4	Pre-requisite (if any)	As per program
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Compete with data curation and standardization.</li> <li>• Compete with the data validation and interpretation.</li> <li>• Develop competency in standardized genetic prediction.</li> <li>• Develop competency in standardized proteomic prediction</li> </ul>
6	Credit Value	03 Credits      (Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100      Min Passing Marks: 40
<b>Part B: Content of Course (Theory)</b>		
Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	<b>Central tendencies and significance</b> <ol style="list-style-type: none"> <li>1. Pictorial representation of data (graphical and tabular).</li> <li>2. Mean, Median, Mode.</li> <li>3. Measure of Dispersion: Standard Deviation, standard error</li> <li>4. Test of Significance: Based on t distribution, Fisher 'Z' test, and Chi-Square test.</li> </ol>	12 (12 Hrs)
II	<b>Applications of biostatistics</b> <ol style="list-style-type: none"> <li>1. Analysis of Variance: One-way Analysis of variance, Two-way Analysis of variance.</li> <li>2. Probability: Calculation of Probability, Events, Addition Theorem, Multiplication Theorem, Bernoulli's Theorem, Bayer's Theorem.</li> <li>3. Correlation: Types of correlation, Degree of correlation, Different methods to find out correlation.</li> <li>4. Regression: Linear Regression, Regression coefficient.</li> </ol>	11 (11 Hrs)
III	<b>Basics of bioinformatics</b> <ol style="list-style-type: none"> <li>1. Introduction to biological databases.</li> <li>2. NCBI, Entrez.</li> <li>3. Sequence alignment.</li> <li>4. Gene prediction.</li> </ol>	11 (11 Hrs)
IV	<b>Applications of bioinformatics</b> <ol style="list-style-type: none"> <li>1. Profiles and Hidden Markov Models.</li> <li>2. Protein motifs and domain prediction.</li> <li>3. Protein structure prediction.</li> <li>4. Phylogenetics.</li> </ol>	11 (11 Hrs)
Keywords	Central Tendencies, Test of Significance, NCBI, Phylogenetics.	

• Part C - Learning Resource	
<b>Text Books, Reference Books, Other Resources -</b>	
Text books- Introduction to Biostatistics- PK Banerjee Elements of Biostatistics- Satguru Prasad Bioinformatics: principles and applications- Zhumur Ghosh	
<ul style="list-style-type: none"> <li>Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins Second Edition; Andreas D. Baxevanis &amp; B. F. Francis Ouellette.</li> <li>Practical Bioinformatics; Janusz M. Bujnicki (Ed.)</li> <li>Introduction to Bioinformatics; Arthur M. Lesk, University of Cambridge.</li> <li>Bioinformatics and Drug Discovery; Richard S. Larson.</li> <li>Bioinformatics; Andrzej Polanski, Marek Kimmel.</li> </ul>	
Online resources- <a href="https://onlinecourses.nptel.ac.in/noc19_bt19/preview">https://onlinecourses.nptel.ac.in/noc19_bt19/preview</a> <a href="https://onlinecourses.nptel.ac.in/noc21_bt06/preview">https://onlinecourses.nptel.ac.in/noc21_bt06/preview</a>	

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	100 Marks	
<b>Continuous Internal Assessment (CIA):</b>	30 Marks	
<b>End Semester Exam (ESE):</b>	70 Marks	
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	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
<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</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:

  
 Ashwini Kanti Sahas  
  
 Amrit Rande  
  
 Neel Behar  
  
 Dr. Ujjwal Singh  
  
 Dr. Shubha Divan  
  
 Dr. Shivani Sharma  
  
 Dr. Sanjasa Bhagat  
  
 Dr. Pramod Malsh  
  
 Dr. Anu Kr. Kishore

**Four Year Undergraduate Program (2024-28)**  
**Department of Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem
Session: 2024-2025		
1	Course Code	<b>BTSC-08-P</b>
2	Course Title	<b>Biostatistics and Bioinformatics</b>
3	Course Type	Discipline Specific Course (DSC) - Practical
4	Pre-requisite (if any)	As per program
5	Course Learning Outcomes (CLO)	After completing this practice course, the students will be able to - <ul style="list-style-type: none"> <li>• Understand and present the data.</li> <li>• Standardize and validate the significance of the data.</li> <li>• Explore database for nucleic acid and genes.</li> <li>• Explore and interpret database for proteins.</li> </ul>
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50      Min Passing Marks: 20

<b>Part B: Content of Course</b>		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	<ol style="list-style-type: none"> <li>1. Graphical presentation of data.</li> <li>2. Tabular presentation of data.</li> <li>3. Measurement of central tendencies from given data.</li> <li>4. Measurement of test of significance from given data.</li> <li>5. Literature mining using PubMed Central.</li> <li>6. Browse the ExpASY sites and write the information received in your record.</li> <li>7. Retrieving Protein and DNA Sequences using Entrez at NCBI.</li> <li>8. Retrieving Protein and DNA Sequences using SRS at EBI</li> <li>9. Nucleotide BLAST – Search nucleotide database using nucleotide query.</li> <li>10. Protein BLAST – Search Protein database using protein query</li> <li>11. BLAST – X: Search the Protein database using a translated nucleotide query</li> <li>12. Multiple Sequence Alignment – CLUSTALW.</li> <li>13. Problems on biostatistics.</li> </ol>	30
Keywords	Central Tendencies, Test of Significance, NCBI, Phylogenetics.	

• Part C - Learning Resource
<b>Text Books, Reference Books, Other Resources -</b>
Text books- Introduction to Biostatistics- PK Banerjee

<p>Elements of Biostatistics- Satguru Prasad          Bioinformatics: principles and applications- Zhumur Ghosh</p>
<ul style="list-style-type: none"> <li>• Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins Second Edition; Andreas D. Baxevanis &amp; B. F. Francis Ouellette.</li> <li>• Practical Bioinformatics; Janusz M. Bujnicki (Ed.)</li> <li>• Introduction to Bioinformatics; Arthur M. Lesk, University of Cambridge.</li> <li>• Bioinformatics and Drug Discovery; Richard S. Larson.</li> <li>• Bioinformatics; Andrzej Polanski, Marek Kimmel.</li> </ul>
<p>Online resources- <a href="https://onlinecourses.nptel.ac.in/noc19_bt19/preview">https://onlinecourses.nptel.ac.in/noc19_bt19/preview</a>  <a href="https://onlinecourses.nptel.ac.in/noc21_bt06/preview">https://onlinecourses.nptel.ac.in/noc21_bt06/preview</a></p>

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	<b>50 Marks</b>	
<b>Continuous Internal Assessment (CIA):</b>	<b>15 Marks</b>	
<b>End Semester Exam (ESE):</b>	<b>35 Marks</b>	
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	Internal Test / Quiz-(2): <b>10 +10</b> Assignment / Seminar + Attendance- <b>05</b> Total Marks - <b>15</b>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against <b>15</b> Marks
<b>End Semester Exam (ESE):</b>	<b>Laboratory / Field Skill Performance:</b> A. On spot Assessment - <b>20 Marks</b> B. Spotting based on tools & technology (written) – <b>10 Marks</b> C. Viva-voce (based on principle/technology) - <b>05 Marks</b>	Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:

Handwritten signatures of the Convener and Members of CBoS in blue ink. The signatures are: 1. A signature starting with 'K'. 2. A signature starting with 'A'. 3. A signature starting with 'G'. 4. A signature starting with 'N'. 5. A signature starting with 'S'. 6. A signature starting with 'S'. 7. A signature starting with 'A'.

**Four Year Undergraduate Program (2024-28)**  
**Department of Biotechnology**  
**Course Curriculum**

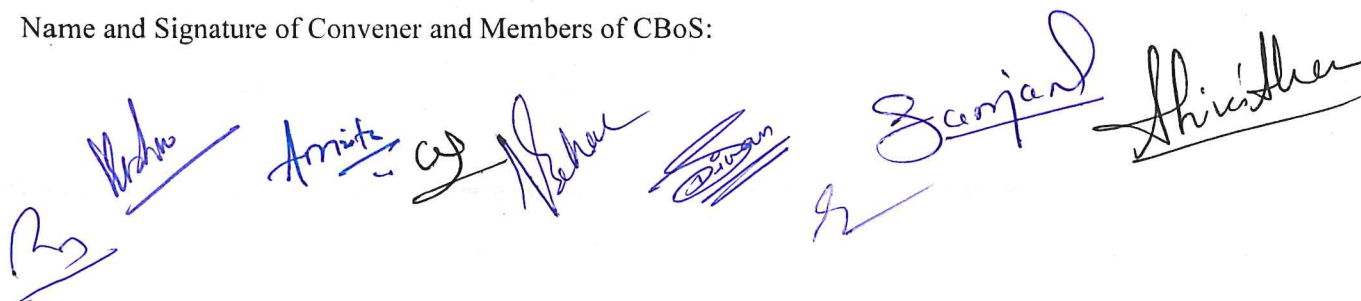
<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)	Semester: VIII Sem	Session: 2024-2025
1	Course Code	BTSE-09-T
2	Course Title	Microbial products for human consumption
3	Course Type	Discipline Specific Elective course (DSE)
4	Pre-requisite (if any)	As per program
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Understand the concept of antibiotic fermentation and application.</li> <li>• Develop concepts for the production of various pharmaceuticals.</li> <li>• Develop an understanding of biotechnological approaches for food and nutraceuticals.</li> <li>• Develop a skill in the production of various kinds of alcoholic drinks.</li> </ul>
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100      Min Passing Marks: 40
<b>Part B: Content of Course (Theory)</b>		
Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	<b>Antibiotics and microbes</b> <ol style="list-style-type: none"> <li>1. Antibiotic fermentations for production of <math>\beta</math> lactams (penicillins), semi-synthetic penicillins and cephalosporins.</li> <li>2. Antibiotic fermentations for production of amino-glycosides (streptomycin).</li> <li>3. Antibiotic fermentations for the production of macrolids (erythromycin).</li> <li>4. Antibiotic fermentations for the production of quinines.</li> </ol>	12 (12 hrs)
II	<b>Microbes and metabolic products</b> <ol style="list-style-type: none"> <li>1. Production of vitamins (B12, riboflavin, A),</li> <li>2. Production of enzymes for pharmaceutical industries,</li> <li>3. Production of recombinant proteins (insulin, interleukins and interferons),</li> <li>4. Biotransformations - hormones</li> </ol>	11 (11 hrs)
III	<b>Microbes and food technology</b> <ol style="list-style-type: none"> <li>1. Microbes in the food industry.</li> <li>2. Biotechnological approaches for fermented foods (breads, sauerkraut, pickles, tofu),</li> <li>3. Biotechnological approaches for dairy products (cheese, curd, yogurt)</li> <li>4. Microbes as food - single cell protein, mushrooms, probiotics.</li> </ol>	11 (11 hrs)
IV	<b>Microbes and beverages</b> <ol style="list-style-type: none"> <li>1. Production of beer (brewing) – media (raw materials used), process, maturation, carbonation.</li> </ol>	11 (11 hrs)

	2. Types of beer (lager, pilsner, bock, ale, stout, porter). 3. Types and production – Whiskey. 4. Production of wine – media and raw material used, different types (sparkling wine, burned wine, cider, wine vinegar), vinegar.	
Keywords	Fermentation, Biotransformations, Wine Production, Single Cell Protein.	

<b>• Part C - Learning Resource</b>	
<b>Text Books, Reference Books, Other Resources -</b>	
<ul style="list-style-type: none"> <li>➤ Text book-</li> <li>➤ <b>Microbial Products for Health, Environment and Agriculture- PK Aurora</b></li> <li>➤ <b>Microbial Products- S Singh</b></li> </ul>	
<ul style="list-style-type: none"> <li>• Industrial Microbiology- A.H. Patel.</li> <li>• Microbiology- Pelczar&amp;Pelczar.</li> <li>• Principles of Fermentation Technology; Stanburry.</li> <li>• Industrial Microbiology; Casida.</li> </ul>	
<ul style="list-style-type: none"> <li>• Online resources- <a href="https://archive.nptel.ac.in/courses/102/103/102103015/">https://archive.nptel.ac.in/courses/102/103/102103015/</a></li> <li>• <a href="https://onlinecourses.swayam2.ac.in/cec19_ag03/preview">https://onlinecourses.swayam2.ac.in/cec19_ag03/preview</a></li> </ul>	

<b>Part D: Assessment and Evaluation</b>		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	<b>100 Marks</b>	
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>	
<b>End Semester Exam (ESE):</b>	<b>70 Marks</b>	
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	Internal Test / Quiz-(2): <b>20 +20</b> Assignment / Seminar - <b>10</b> Total Marks - <b>30</b>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against <b>30</b> Marks
<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</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 Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem      Session:2024-2025
1	Course Code	<b>BTSE-10</b>
2	Course Title	<b>Microbial products for agriculture</b>
3	Course Type	Discipline Specific Elective course (DSE)
4	Pre-requisite (if any)	As per program
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Develop skills in biofertilizer production.</li> <li>• Develop skills in biopesticide production.</li> <li>• Develop skills in BT-based GM crop development.</li> <li>• Understand bio composting, biofuels, and metal recovery.</li> </ul>
6	Credit Value	03 Credits      (Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100      Min Passing Marks: 40
<b>Part B: Content of Course (Theory)</b>		
Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	<b>Microbes and biofertilizers</b> <ol style="list-style-type: none"> <li>1. Biofertilizers – history of, production of biofertilizers.</li> <li>2. Production of biofertilizers from symbiotic and asymbiotic nitrogen fixers.</li> <li>3. Phosphate solubilizing microbes, phytohormones from microbes.</li> <li>4. Applications of microbes in fields.</li> </ol>	12 (12 hrs)
II	<b>Microbes and biopesticides</b> <ol style="list-style-type: none"> <li>1. Biopesticides-history of development.</li> <li>2. Production of biopesticides from bacteria.</li> <li>3. Production of biopesticides from fungi and viruses.</li> <li>4. Production of biopesticides from insect hormones.</li> </ol>	11 (11 hrs)
III	<b>Transgenicity</b> <ol style="list-style-type: none"> <li>1. Bacillus thuringiensis (Bt) as a major biopesticide.</li> <li>2. Role of Bt in pest control</li> <li>3. Transgenic crops from Bt.</li> <li>4. Issues related to GM crops</li> </ol>	11 (11 hrs)
IV	<b>Microbial role in geological product</b> <ol style="list-style-type: none"> <li>1. Composting – static pile, aerated pile.</li> <li>2. Bioreactor process for composting.</li> <li>3. Biofuels – ethanol, methane, hydrogen, and biogas.</li> <li>4. Recovery of metals – bioleaching of copper, gold, and uranium.</li> </ol>	11 (11 hrs)
Keywords	Biofertilisers, Biopesticides, Transgenic Crops, Composting.	

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*Anita*  
*.. G. J. Babar*

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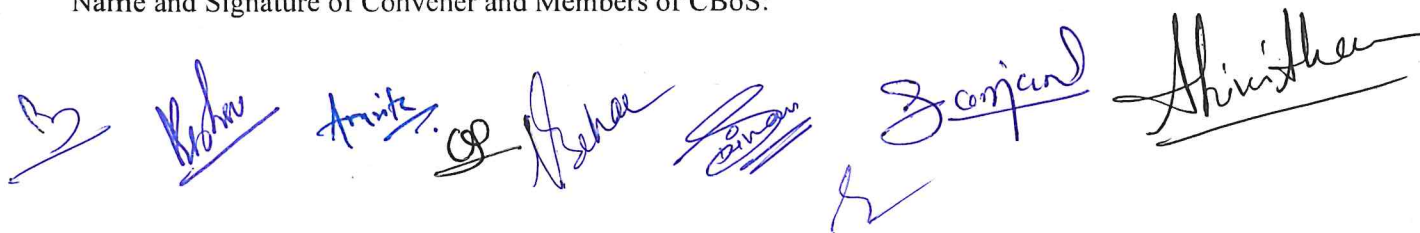
*Sanjand*  
*K*

*Shirisha*

• Part C - Learning Resource	
<b>Text Books, Reference Books, Other Resources -</b>	
<ul style="list-style-type: none"> <li>• Text book- Industrial Microbiology- A.H. Patel.</li> <li>• Gupta PK ad genetics and biotechnology in crop improvement- Rastogi Publication</li> <li>• Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanoical publication.</li> </ul>	
References book- <ul style="list-style-type: none"> <li>• Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication.</li> <li>• Vyas S and Modi HA- Biofertilisers and organic farming- AKTA Prakashan</li> <li>• Microbiology- Pelczar &amp; Pelczar.</li> <li>• Principles of Fermentation Technology; Stanburry.</li> <li>• Industrial Microbiology; Casida.</li> </ul>	
Online resources- <a href="https://archive.nptel.ac.in/courses/126/105/126105013/">https://archive.nptel.ac.in/courses/126/105/126105013/</a> <a href="https://onlinecourses.swayam2.ac.in/cec19_ag03/preview">https://onlinecourses.swayam2.ac.in/cec19_ag03/preview</a>	

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	<b>100 Marks</b>	
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>	
<b>End Semester Exam (ESE):</b>	<b>70 Marks</b>	
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	Internal Test / Quiz-(2): <b>20 +20</b> Assignment / Seminar - <b>10</b> Total Marks - <b>30</b>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</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 Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: <b>VIII Sem</b> Session: 2024-2025
1	Course Code	<b>BTSE-11-T</b>
2	Course Title	<b>Microbial products for industrial use and application</b>
3	Course Type	Discipline Specific Elective course (DSE)
4	Pre-requisite (if any)	As per program.
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Develop skills in the production of sugar-based products.</li> <li>• Develop skills in the production acid acid-based products.</li> <li>• Develop skills in the production of alcohol-based products.</li> <li>• Develop skills in microbial production at the industrial level.</li> </ul>
6	Credit Value	03 Credits      (Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100      Min Passing Marks: 40
<b>Part B: Content of Course (Theory)</b>		
Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	<b>Production of enzymes</b> <ol style="list-style-type: none"> <li>1. Production and applications of amylase, proteases, and invertase.</li> <li>2. Production and applications of pectinase and cellulase.</li> <li>3. Production and applications of glucose oxidase and glucose isomerase.</li> <li>4. Production and applications of catalase, lipase, and polymerase.</li> </ol>	12 (12 hrs)
II	<b>Production of acids</b> <ol style="list-style-type: none"> <li>1. Production and applications of citric acid and fumaric acid.</li> <li>2. Production and applications of lactic acid and benzoic acid.</li> <li>3. Production and applications of gluconic acid and kojic acid.</li> <li>4. Production and applications of itaconic acid and acetic acid.</li> </ol>	11 (11 hrs)
III	<b>Production of alcohol and glycerol</b> <ol style="list-style-type: none"> <li>1. Production and applications of industrial alcohol,</li> <li>2. Production and applications of acetone-butanol</li> <li>3. Production and applications of glycerol from yeasts.</li> <li>4. Production and applications of glycerol from bacteria.</li> </ol>	11 (11 hrs)
IV	<b>Production of pigments and others</b> <ol style="list-style-type: none"> <li>1. Microbial production of xanthene, dextrane, and alginate.</li> <li>2. Microbial production of gellan, cellulose and curdlan.</li> <li>3. Microbial production of pullulan and scleroglucan.</li> <li>4. Microbial production of polyesters - bioplastics (polyhydroxyalkanoates).</li> </ol>	11 (11 hrs)
Keywords	Amylase, Lactic Acid, Glycerol, Bioplastics.	

• Part C - Learning Resource	
<b>Text Books, Reference Books, Other Resources -</b>	
Text book-	<ul style="list-style-type: none"> <li>➤ Hand book of fermentation technology- E S Minj</li> <li>➤ Industrial Microbiology- A.H. Patel.</li> </ul>
Reference book-	<ul style="list-style-type: none"> <li>• Wastewater Engineering- Treatment, Disposal &amp; Reuse. Metall and Eddy, Inc., Tata Mcgraw Hill, N. Delhi.</li> <li>• Microbiology- Pelczar&amp;Pelczar.</li> <li>• Environmental Biotechnology, PrathamVashishith. Dominant Publishers And Distributors, N.Delhi.</li> <li>• Principles of Fermentation Technology; Stanburry.</li> <li>• Industrial Microbiology; Casida.</li> </ul>
Online resources- <a href="https://onlinecourses.nptel.ac.in/noc20_bt21/preview">https://onlinecourses.nptel.ac.in/noc20_bt21/preview</a> <a href="https://unacademy.com/content/cbse-class-12/study-material/biology/microbes-in-industrial-products/">https://unacademy.com/content/cbse-class-12/study-material/biology/microbes-in-industrial-products/</a>	

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	<b>100 Marks</b>	
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>	
<b>End Semester Exam (ESE):</b>	<b>70 Marks</b>	
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	Internal Test / Quiz-(2): <b>20 +20</b> Assignment / Seminar - <b>10</b> Total Marks - <b>30</b>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</b> Section A: <b>Q1.</b> Objective – 10 x1= 10 Mark; <b>Q2.</b> 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 (2024-2028)**  
**Department of Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)	Semester: VIII Sem	Session: 2024-2025
1	Course Code	<b>BTSE-12-T</b>
2	Course Title	<b>IPR, Biosafety, and Bioethics.</b>
3	Course Type	Discipline Specific Elective course (DSE)
4	Pre-requisite (if any)	As per program
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Generate basic concepts related to intellectual property.</li> <li>• Develop skills related to patenting and registration of geographical indications.</li> <li>• Develop concepts related to biosafety and its regulation.</li> <li>• Develop skills related to the assessment of biotechnological products.</li> </ul>
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100      Min Passing Marks: 40
<b>Part B: Content of Course (Theory)</b>		
Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	<b>Basic concepts of IPR</b> <ol style="list-style-type: none"> <li>1. Patent laws, patent application procedure.</li> <li>2. Copyright laws, ownership, and enforcement of copyrights.</li> <li>3. Patents and copyrights, transfer.</li> <li>4. Trademarks – objectives, rights, and protection.</li> </ol>	12 (12 hrs)
II	<b>Rights and Conservation</b> <ol style="list-style-type: none"> <li>1. Intellectual property rights.</li> <li>2. Biotechnology and IPR, issues in patenting biotechnological inventions, commercial potential of biotechnology inventions,</li> <li>3. Patenting of life forms (GEMs) – objectives, rationale, international treaties, Indian perspectives.</li> <li>4. Geographical indications.</li> </ol>	11 (11 hrs)
III	<b>Legal protection of biosafety</b> <ol style="list-style-type: none"> <li>1. Biosafety regulation of products.</li> <li>2. Individual, national, and international concerns of biosafety.</li> <li>3. Biosafety regulations in laboratories.</li> <li>4. Handling of recombinant products.</li> </ol>	11 (11 hrs)
IV	<b>Protocol and assessment</b> <ol style="list-style-type: none"> <li>1. Assessment of the impact of transgenic crops- foods, drugs, and vaccines.</li> <li>2. Assessment of recombinant products.</li> <li>3. International biosafety protocols</li> </ol>	11 (11 hrs)

	4. Biological weapons and their control.	
Keywords	Patent, Trademark, Copyright, Geographical Indications.	

<b>• Part C - Learning Resource</b>	
<b>Text Books, Reference Books, Other Resources -</b>	
Text book-	
<ul style="list-style-type: none"> <li>• IPR, Biosafety, and Bioethics by Goel and Parashar.</li> <li>• Intellectual property rights, biosafety, and bioethics (ethical frontiers) by <u>Dr. Alok Kumar Srivastav et al.</u></li> </ul>	
Reference Book-	
<ul style="list-style-type: none"> <li>• PR Handbook for Pharma Students and Researchers- P Bansal.</li> <li>• Law relating to intellectual property right- V K Ahuja.</li> </ul>	
Online resources- <a href="https://onlinecourses.nptel.ac.in/noc21_lw04/preview">https://onlinecourses.nptel.ac.in/noc21_lw04/preview</a>	
<a href="https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=qpl3yaiUxBHqOVkf/L23mw==">https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=qpl3yaiUxBHqOVkf/L23mw==</a>	

<b>Part D: Assessment and Evaluation</b>		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>	<b>100 Marks</b>	
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>	
<b>End Semester Exam (ESE):</b>	<b>70 Marks</b>	
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	Internal Test / Quiz-(2): <b>20 +20</b> Assignment / Seminar - <b>10</b> Total Marks - <b>30</b>	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
<b>End Semester Exam (ESE):</b>	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., out of 2 from each unit-4x10=40 Marks	

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**Four Year Undergraduate Program (2024-28)**  
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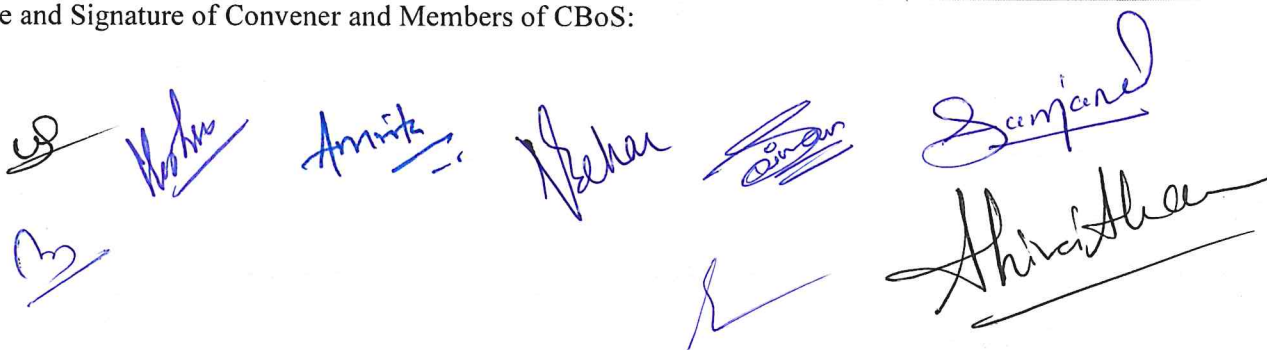
<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem      Session:2024-2025
1	Course Code	<b>BTSE-09-P</b>
2	Course Title	<b>Microbial products for human consumption</b>
3	Course Type	Discipline-Specific Elective (DSE)--Practical
4	Pre-requisite (if any)	As per program.
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Develop skills for antibiotic production,</li> <li>• Develop skills for enzymatic production.</li> <li>• Develop skills for nutraceutical production.</li> </ul>
6	Credit Value	01 Credits    Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50      Min Passing Marks: 20

<b>Part B: Content of Course (Theory)</b>		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	<ol style="list-style-type: none"> <li>1) Production of Penicillin by using microbes.</li> <li>2) Production of enzymes by using microbes.</li> <li>3) Preparation of fermented food, viz., bread, tofu, etc.</li> <li>4) Production of yogurt, and cheese by using microbes.</li> <li>5) Production of alcohol by using microbes.</li> </ol>	30
Keywords	Fermentation, Biotransformations, Wine Production, Single Cell Protein.	

<b>Part C - Learning Resource</b>
<b>Text Books, Reference Books, Other Resources -</b>
<ul style="list-style-type: none"> <li>➤ Text book-</li> <li>➤ <b>Microbial Products for Health, Environment and Agriculture- PK Aurora</b></li> <li>➤ <b>Microbial Products- S Singh</b></li> </ul>
<ul style="list-style-type: none"> <li>• Industrial Microbiology- A.H. Patel.</li> <li>• Microbiology- Pelczar&amp;Pelczar.</li> <li>• Principles of Fermentation Technology; Stanburry.</li> <li>• Industrial Microbiology; Casida.</li> </ul>
<ul style="list-style-type: none"> <li>• Online resources- <a href="https://archive.nptel.ac.in/courses/102/103/102103015/">https://archive.nptel.ac.in/courses/102/103/102103015/</a></li> <li>• <a href="https://onlinecourses.swayam2.ac.in/cec19_ag03/preview">https://onlinecourses.swayam2.ac.in/cec19_ag03/preview</a></li> </ul>

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks: 50 Marks</b>		
<b>Continuous Internal Assessment (CIA): 15 Marks</b>		
<b>End Semester Exam (ESE): 35 Marks</b>		
<b>Continuous Internal Assessment (CIA) (By course teacher):</b>	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
<b>End Semester Exam (ESE):</b>	<b>Laboratory / Field Skill Performance:</b> A. On spot Assessment - 20 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 and Members of CBoS:


 A series of handwritten signatures in blue ink, including names like 'Vishnu', 'Amrita', 'Debar', 'Suman', 'Sampad', and 'Shirisha'.

**Four-Year Undergraduate Program (2024-28)**  
**Department of Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem    Session: 2024-2025
1	Course Code	BTSE-10-P
2	Course Title	Microbial products for agriculture
3	Course Type	Discipline-Specific Elective (DSE)--Practical
4	Pre-requisite (if any)	As per program.
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Isolate and maintain symbiotic and a symbiotic microorganism</li> <li>• Develop skill for biofertilizer and biopesticide production.</li> <li>• Develop skill for genetic modification of plants.</li> <li>• Develop skill for fertilizer developments.</li> </ul>
6	Credit Value	01 Credits    Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50    Min Passing Marks: 20

<b>Part B: Content of Course (Theory)</b>		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	<ol style="list-style-type: none"> <li>1. Isolation and characterization of asymbiotic bacteria.</li> <li>2. Isolation and characterization of symbiotic bacteria.</li> <li>3. Isolation and characterization of <i>Bacillus thuringensis</i> (BT).</li> <li>4. Preparation of biofertilizers by using microbes.</li> <li>5. Preparation of biopesticides by using plant products.</li> <li>6. Determination of comparative efficiency of plant-based biofertilisers.</li> <li>7. Determination of comparative efficiency of plant-based biopesticides against various pests.</li> <li>8. Comparative study on growth of plant by using non-Bt and Bt strains.</li> <li>9. Preparation of compost.</li> <li>10. Comparative study of the efficacy of compost and inorganic fertilizers.</li> </ol>	30
Keywords	Biofertilisers, Biopesticides, Transgenic Crops, Composting.	

<b>Part C - Learning Resource</b>
<b>Text Books, Reference Books, Other Resources -</b>
<ul style="list-style-type: none"> <li>• Text book- Industrial Microbiology- A.H. Patel.</li> <li>• Gupta PK ad genetics and biotechnology in crop improvement- Rastogi Publication</li> <li>• Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanical publication.</li> </ul>
References book- <ul style="list-style-type: none"> <li>• Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication.</li> <li>• Vyas S and Modi HA- Biofertilisers and organic farming- AKTA Prakashan</li> <li>• Microbiology- Pelczar &amp; Pelczar.</li> </ul>

<ul style="list-style-type: none"> <li>Principles of Fermentation Technology; Stanburry.</li> <li>Industrial Microbiology; Casida.</li> </ul>
Online resources- <a href="https://archive.nptel.ac.in/courses/126/105/126105013/">https://archive.nptel.ac.in/courses/126/105/126105013/</a> <a href="https://onlinecourses.swayam2.ac.in/cec19_ag03/preview">https://onlinecourses.swayam2.ac.in/cec19_ag03/preview</a>

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>		<b>50 Marks</b>
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<b>End Semester Exam (ESE):</b>		<b>35 Marks</b>
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Name and Signature of Convener and Members of CBoS:

**Four Year Undergraduate Program (2024-28)**  
**Department of Biotechnology**  
**Course Curriculum**

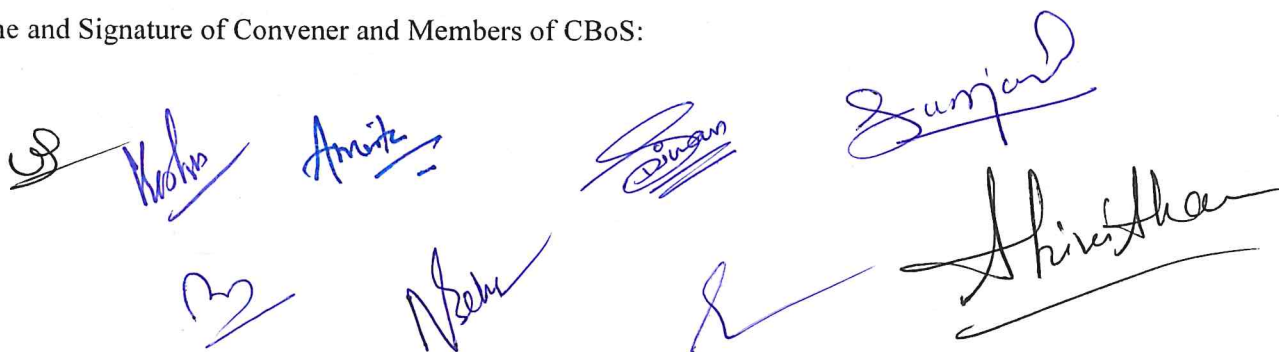
<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem      Session: 2024-2025
1	Course Code	<b>BTSE-11-P</b>
2	Course Title	<b>Microbial products for industrial use and application</b>
3	Course Type	Discipline-Specific Elective (DSE)--Practical
4	Pre-requisite (if any)	As per program.
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Develop skills industrially useful enzymes.</li> <li>• Develop skills for industrially usable microbes.</li> <li>• Develop skills for production of organic acids.</li> <li>• Develop skills for industrially significant microbes.</li> </ul>
6	Credit Value	01 Credits      Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50      Min Passing Marks: 20
<b>Part B: Content of Course (Theory)</b>		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Production of amylase using microbes. 2. Production of catalase using microbes. 3. Production of lipase using microbes. 4. Production of organic acids using microbes. 5. Production of alcohol using microbes. 6. Culture and maintenance of industrially significant bacteria. 7. Culture and maintenance of industrially significant yeast and fungus.	30
Keywords	Amylase, Lactic Acid, Glycerol, Bioplastics.	

<b>• Part C - Learning Resource</b>
<b>Text Books, Reference Books, Other Resources -</b>
Text book- <ul style="list-style-type: none"> <li>➤ Hand book of fermentation technology- E S Minj</li> <li>➤ Industrial Microbiology- A.H. Patel.</li> </ul>
Reference book- <ul style="list-style-type: none"> <li>• Wastewater Engineering- Treatment, Disposal &amp; Reuse. Metall and Eddy, Inc., Tata Mcgraw Hill, N. Delhi.</li> <li>• Microbiology- Pelczar&amp;Pelczar.</li> <li>• Environmental Biotechnology, PrathamVashishith. Dominant Publishers And Distributors, N.Delhi.</li> <li>• Principles of Fermentation Technology; Stanburry.</li> <li>• Industrial Microbiology; Casida.</li> </ul>

Online resources- [https://onlinecourses.nptel.ac.in/noc20\\_bt21/preview](https://onlinecourses.nptel.ac.in/noc20_bt21/preview)  
<https://unacademy.com/content/cbse-class-12/study-material/biology/microbes-in-industrial-products/>

Part D: Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
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Name and Signature of Convener and Members of CBoS:



**Four-Year Undergraduate Program (2024-2025)**  
**Department of Biotechnology**  
**Course Curriculum**

<b>Part A: Introduction</b>		
Program: Bachelor in Life Sciences (Honors)		Semester: VIII Sem      Session: 2024-2025
1	Course Code	<b>BTSE-12-P</b>
2	Course Title	<b>IPR, Biosafety, and Bioethics.</b>
3	Course Type	Discipline-Specific Elective (DSE)--Practical
4	Pre-requisite (if any)	As per program.
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Understand about the industrial property right.</li> <li>• Develop skill for patent filing.</li> <li>• Develop competency for local right protection.</li> <li>• Develop competency for protection of commerce and literary outcomes.</li> </ul>
6	Credit Value	01 Credits      Credit =30 Hours Laboratory or Field learning/Training
7	Total Marks	Max. Marks: 50      Min Passing Marks: 20

<b>Part B: Content of Course (Theory)</b>		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Preparation of application for patent filing. 2. Suitability study for patenting of products. 3. Suitability study for geographical indications. 4. Suitability study for trademark. 5. Suitability study for copyright claim.	30
Keywords	Patent, Trademark, Copyright, Geographical Indications.	

<b>Part C - Learning Resource</b>
<b>Text Books, Reference Books, Other Resources -</b>
Text book- <ul style="list-style-type: none"> <li>• IPR, Biosafety, and Bioethics by Goel and Parashar.</li> <li>• Intellectual property rights, biosafety, and bioethics (ethical frontiers) by <u>Dr. Alok Kumar Srivastav et al.</u></li> </ul>
Reference Book- <ul style="list-style-type: none"> <li>• PR Handbook for Pharma Students and Researchers- P Bansal.</li> <li>• Law relating to intellectual property right- V K Ahuja.</li> </ul>
Online resources- <a href="https://onlinecourses.nptel.ac.in/noc21_1w04/preview">https://onlinecourses.nptel.ac.in/noc21_1w04/preview</a> <a href="https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=qpl3yaiUxBHqOVkf/L23mw==">https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=qpl3yaiUxBHqOVkf/L23mw==</a>

Part D: Assessment and Evaluation		
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