

DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

| PART- A: Introduction | | | |
|--|--|---|---|
| Program: Bachelor in Science (Honors/Honors with research) | | Semester - VII | Session: 2024-25 |
| 1 | Course Code | CHSC-07T | |
| 2 | Course Title | INORGANIC & PHYSICAL 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"> ➤ Study the formation, stability and electronic spectra of complexes ➤ Analyze the chemistry of metal carbonyls and metal nitrosyls. ➤ Solve the Schrodinger equation for the hydrogen atom and utilize Huckel theory for conjugated systems. ➤ Analyze collision theory and transition state theory to understand chemical reactions. | |
| 6 | Credit Value | 3 Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | No. of Period | |
| I | MOT & Electronic Spectra of Complexes Electronic spectra and MO theory of Transition Metal complexes , M.O. Theory for octahedral, tetrahedral and square planar complexes with and without π -bonding Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule for term symbol, Hole formalism, Determination of the term symbol (ground and excited states) for d 1 to d 9 configurations, Electronic spectra of transition metal complexes, Types of transitions, Laporte 'orbital' selection rule, spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of $10Dq$, B, β parameters. Tanabe- Sugano Diagrams of octahedral complexes with d 2 and d8 configuration. | 12 | |
| II | Metal – Ligand Equilibria A) Metal – Ligand Equilibria in Solution: Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodynamic origin. Determination of formation constant by: (1) spectrophotometric method (Job's and Mole ratio method) (2) Potentiometric method (Irving-Rossotti Method) B) Reaction Mechanism of Transition metal complexes- : Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution C) Metal carbonyls : vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Metal carbonyl clusters with reference to classification, synthesis and structures. D) Metal nitrosyls : Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation. | 11 | |
| III | Advanced Quantum Mechanics Discussion of solutions of the Schrodinger equation to three - dimensional box, concept of degeneracy, the harmonic oscillator, the rigid rotor, the hydrogen atom. Approximate Methods | 11 | |

| | | |
|----------|--|----|
| | <p>The variation theorem and perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to hydrogen and helium atom.</p> <p>Angular Momentum</p> <p>Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetry and Pauli's exclusion principle.</p> <p>Molecular Orbital Theory</p> <p>Huckel theory of conjugated systems, Applications to ethylene, butadiene and cyclobutadiene.</p> | |
| IV | <p>Advanced Chemical Dynamics</p> <p>A) Methods of determining rate laws, Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations, Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates, kinetic salt effects. Kinetics of Photochemical reactions (Hydrogen-bromine and hydrogen - chlorine reactions).</p> <p>B) Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions :Lindeman-Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation.</p> | 11 |
| Keywords | <p><i>Electronic spectra, MO theory, Complex stability, Spectrophotometry, Vibrational spectra, Bonding, Metal nitrosyls, Schrodinger equation, Huckel theory, Collision theory, Transition state theory</i></p> | |

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. Bali, R. (2014). *Principles of inorganic chemistry (5th ed.)*. New Age International.
2. Prasad, R. K. (2012). *Quantum mechanics (3rd ed.)*. New Age International.
3. Puri, B. R., Sharma, L. R., & Rastogi, V. D. (2012). *A textbook of physical chemistry*. Vishwa Prakashan.
4. Rakshit, P. C. (2014). *Elements of physical chemistry*. S. Chand & Company.

Reference Books Recommended:-

1. Lee, J. D. (2008). *Inorganic chemistry (4th ed.)*. Wiley India.
2. Greenwood, N. N., & Earnshaw, A. (2012). *Chemistry of the elements (2nd ed.)*. Elsevier.
3. Laidler, K. J. (1987). *Chemical kinetics (3rd ed.)*. Pearson Education.
4. Cotton, F. A., Wilkinson, G., Boch, P. L., & Bailar, M. Bailar Jr. (2018). *Inorganic chemistry (6th ed.)*. John Wiley & Sons.
5. Mathews, P. M., & McFarlane, F. W. (2014). *A textbook of quantum mechanics (2nd ed.)*. Mc Graw Hill Education.
6. Houston, P. L. (2001). *Chemical kinetics and reaction dynamics*. Dover Publications.

Online Resources-

- <https://nptel.ac.in/courses/115106066>
- <https://nptel.ac.in/>
- https://onlinecourses.nptel.ac.in/noc23_cy02/preview
- <https://swayam.gov.in/>

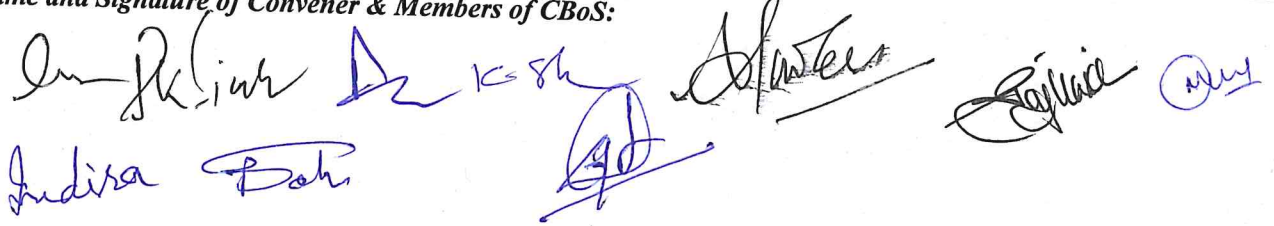
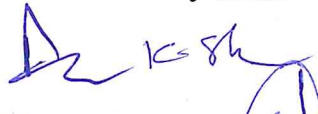





PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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

| | | |
|---|--|---|
| Continuous Internal Assessment (CIA): (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): | Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks | |

Name and Signature of Convener & Members of CBoS:

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

| PART- A: Introduction | | | |
|---|--|--|--|
| Program: Bachelor in Science <i>(Honor/Honors with Research)</i> | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | CHSC-07P | |
| 2 | Course Title | CHEMISTRY LAB. COURSE-VII | |
| 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"> ➤ Master separating and estimating acidic and basic radicals in inorganic mixtures. ➤ Apply qualitative and quantitative analysis skills to real samples. • Inorganic Synthesis & Characterization ➤ Gain hands-on experience synthesizing inorganic compounds and identify them using spectral analysis. ➤ Grasp basic physical chemistry concepts through practical experiments and learn to operate basic equipment. | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |
| PART -B: Content of the Course | | | |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | No. of Period | |
| Lab./Field Training/Experiment Contents of Course | <p>Qualitative analysis of mixture containing eight radicals including two less common metals from among the following by semi micro method.</p> <p>Basic Radicals: Ag, Pb, Hg Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt.</p> <p>Acidic Radicals: Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Fluoride, Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferricyanide, Sulphocyanide, Chromate, Arsinat and Permanganate.</p> <p>Separation and determination of two metal ions in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.</p> <p>Estimations</p> <p>(a) Phosphoric acid in commercial orthophosphoric acid. (b) Boric acid in borax. (c) Ammonia in an ammonium salt. (d) Manganese dioxide in pyrolusite. (e) Available chlorine in bleaching powder. (f) Hydrogen peroxide in a commercial sample.</p> <p>Preparations Preparation of selected inorganic compounds and their study by I.R. Electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds. Theoretical study of structure and their identification of some preparations by spectral analysis</p> | 30 | |

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|--|--|
| 1. VO (acac) ₂ | 2. TiO (C ₉ H ₈ NO) ₂ 2H ₂ O |
| 3. Cis-K [Cr (C ₂ O ₄) ₂ (H ₂ O) ₂] | 4. Na[Cr(NH ₃) ₂ (SCN) ₄] |
| 5. Mn (acac) ₃ | 6. K ₃ [Fe (C ₂ O ₄) ₃] |
| 7. Prussian Blue, Turnbull's Blue. | 8. [Co (NH ₃) ₆][Co(NO ₂) ₆] |
| 9. Cis-[Co(trien)(NO ₂) ₂]Cl.H ₂ O | 10. Hg[Co(SCN) ₄] |
| 11. [Co(Py) ₂ Cl ₂] | 12. [Ni(NH ₃) ₆]Cl ₂ |
| 13. Ni(DMG) ₂ | 14. [Cu(NH ₃) ₄]SO ₄ .H ₂ O |

Adsorption

- 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.

Chemical Kinetics

- Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
- Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

Polarimetry

- Determine the specific and molecular rotation of optically active substance.
- To determine the concentration of a solution of an optically active substance.

Solutions

- Determination of molecular weight of non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
- Determination of molecular weight of non-volatile substances by Landsberger's method.

Spectrophotometry

- Verification of Beer-Lambert law and determination of concentration of unknown solution.
- Effect of pH in aqueous coloured system.

Potentiometry/pH metry

- Determination of temperature dependence of EMF of a cell.
- To determine pK_a of the given monobasic acid by pHmetric titration.
- Determination of the dissociation constant of monobasic/dibasic acid by Albert- Serjeant method.

Keywords

Qualitative Analysis, Separation and Determination, Estimations, Preparations, Spectroscopic Techniques, Adsorption, Chemical Kinetics, Polarimetry, Solutions, Instrumental Methods

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended

1. Das, R. C., & Behra, B. (2009). *Experimental Physical Chemistry (1st Ed.)*. Tata McGraw-Hill Education.
2. Chatwal, G. R., & Sharma, A. (2019). *Instrumental Methods of Chemical Analysis*. Himalaya Publishing House.

Reference Books Recommended

1. Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1974). *Vogel's Textbook of Qualitative Chemical Analysis (5th Ed.)*. ELBS.
2. Jolly, W. L. (1970). *Synthesis and Characterization of Inorganic Compounds*. Prentice Hall.
3. James, A. M., & Prichard, F. E. (1981). *Practical Physical Chemistry (4th Ed.)*. Longman.
4. Plevitt, B. (1974). *Findlay's Practical Physical Chemistry (9th Ed.)*. Longman.

Online Resources-

- (<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 | |
| | S. Performed the Task based on lab. work - 20 Marks | Managed by Course teacher as per lab. status |
| | 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
K. Sh
D. S
S. S
S. S
S. S

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)

DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM

| PART-A: Introduction | | | |
|---|---|---|---|
| Program: Bachelor in Science (Honors/Honors with Research) | | Semester VII | Session: 2024-2025 |
| 1 | CourseCode | CHSE-05T | |
| 2 | CourseTitle | PHOTOCHEMISTRY AND PERICYCLIC REACTION | |
| 3 | CourseType | DSE | |
| 4 | Pre-requisite(if,any) | As per Program | |
| 5 | Course Learning Outcomes(CLO) | <ul style="list-style-type: none"> ➤ To study the photochemical reaction and pericyclic reaction ➤ To gain knowledge about mechanism of light induced reaction. ➤ To learn the mechanism of thermal reaction ➤ To understand the difference between light and thermal reaction. | |
| 6 | CreditValue | 3 Credits | Credit = 15 Hours -learning & Observation |
| 7 | TotalMarks | Max.Marks: 100 | Min Passing Marks:40 |
| PART -B: Content of the Course | | | |
| TotalNo.of Teaching-learning Periods(01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics(Coursecontents) | | No.ofP eriod |
| I | Photochemical reactions and Reaction Mechanism Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecules, quantum yield, transfer of excitation energy, actinometry. Classification, rate constants and life times of reactive energy states - determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions – Photo-oxidation, photo-reduction, photo-dissociation, gas phasephotolysis. | | 12 |
| II | Photochemistry of Alkenes Intramolecular reactions of the olefinic bond - geometrical isomerism, cyclisation reactions, photochemical rearrangement of alkenes, rearrangement 1, 4- and 1,5-dienes. Photochemistry of Aromatic Compounds: Photochemical isomerization of aromatic compounds, Photochemical addition and substitutions reactions shown by aromatic compounds. | | 11 |
| III | Photochemistry of Carbonyl Compounds Photochemical reactions of carbonyl compounds: Norrish type I and II reactions Intramolecular reactions of carbonyl compounds - saturated cyclic and acyclic, β , γ - unsaturated and α , β - unsaturated compounds. Cyclohexadienones. Intermolecular cycloaddition reactions –photo-dimerisation reaction and oxetane formation. Miscellaneous Photochemical Reactions Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. | | 11 |
| IV | Pericyclic Reactions Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffman correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotatory and | | 11 |

disrotatory motions, $4n$, $4n+2$ and allyl systems. Cycloadditions- antarafacial and suprafacial additions, $4n$ and $4n+2$ systems, $2+2$ addition of ketenes. Sigmatropic rearrangements, suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, $3, 3$ - and $5, 5$ - sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements.

Keywords *Photochemical reaction, thermal reaction,*

Signature of Convener & Members (CBoS):

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Singh, J., & Singh, J. (n.d.). *Photochemistry and pericyclic reactions*. [Publisher not provided].
2. Gupta, A. L. (2024). *Photochemistry*. Pragati Prakashan (7th Edition).

Reference books Recommended:

1. Ramamurthy, V., & Schanze, K. S. (1999). *Organic photochemistry*. Taylor & Francis.
2. Wardle, B. (2000). *Principles and applications of photochemistry*. John Wiley & Sons.

Online Resources–

- <https://nptel.ac.in/courses/104105038>
- <https://archive.nptel.ac.in/courses/104/106/104106077/>
- <https://www.scribd.com/document/512848351/Photochemistry-and-Pericyclic-Reactions-by-J-Singh>

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

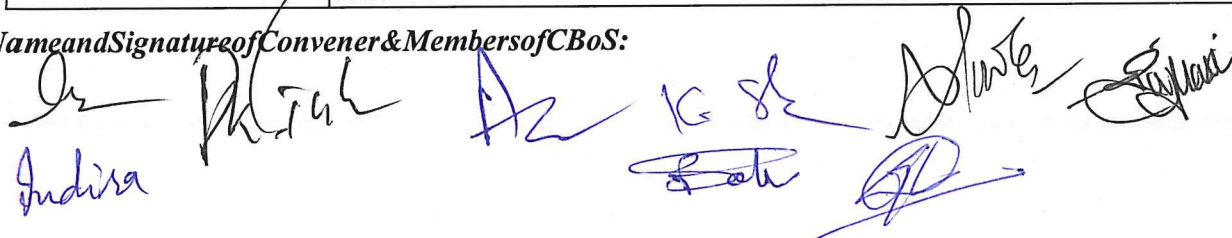
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener & Members of CBoS:



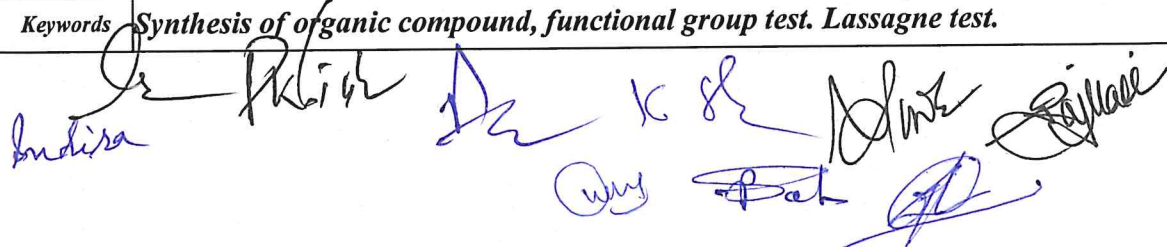
 Indira

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)

DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM

| PART-A: Introduction | | | |
|---|--|---|--|
| Program: Bachelor in Science (Honors/Honors with Research) | | Semester VII | Session: 2024-2025 |
| 1 | CourseCode | CHSE-05P | |
| 2 | CourseTitle | PHOTOCHEMISTRY & PERICYCLIC REACTION LAB. COURSE | |
| 3 | CourseType | DSE | |
| 4 | Pre-requisite(if,any) | - | |
| 5 | Course Learning Outcomes(CLO) | <ul style="list-style-type: none"> ➤ To learn the advanced organic chemistry concept that will applied in solving their future chemistry problems. ➤ To learn about arenium ion ,classical versus non classical carbonium ion ,different rearrangement reactions ➤ To make student aware the level of basic organic chemistry to apply in different reaction mechanisms and organic transformations. | |
| 6 | CreditValue | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | TotalMarks | Max.Marks:50 | Min Passing Marks:20 |
| PART -B: Content oftheCourse | | | |
| TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours) | | | |
| Module | Topics(Coursecontents) | | No.ofP eriod |
| Lab./Field Training/ Experiment Contents of Course | 1. Synthesis of organic compound involving important chemical reaction:- (a)Acetylations salicylic acid, aniline, glucose and hydroquinone, (b) Benzoylation of aniline and phenol. (c) Aliphatic electrophilic substitution: preparation of iodoform from ethanol and acetone (d) Arromatic electrophilic substitution: nitration-preparation of meta dinitrobenzene, p-nitroacetinalide, halogenation: preparation of p-bromoaetanilaide,2,4,6-tribromophenol. (e) Diazotisation/ coupling :- Preparation of methyl orange and methyl red, (f)Oxidation: Preparation of benzoic acid from toluene (g) Reduction: Preparation of aniline from nitrobenzene, m-nitroanilene from m-dinitrobenzene. 2. Isolation of some natural products(casein from milk, lycopene from tomato, nicotine from tobacco leaves etc.) 3. Detection of element, functional group and organic compound. | | 30 |
| Keywords | Synthesis of ofganic compound, functional group test. Lassagne test. | | |


 A series of handwritten signatures in blue ink are located below the table. The signatures are written in cursive and appear to be the names of the faculty members involved in the curriculum development.

Signature of Convener & Members (CBoS):

| PART-C: Learning Resources | | |
|---|---|---|
| Text Books, Reference Books and Others | | |
| Text books Recommended: | | |
| 1. Bansal, R. K. (1994). <i>Laboratory manual of organic chemistry</i> . New Age International Publishers. 2. Vogel Textbook of Practical Organic Chemistry 5 th edition, Pearson Publication. | | |
| Reference books Recommended: | | |
| 1. Vishnoi, N. K. (2010). <i>Advanced practical organic chemistry (3rd ed.)</i> . Vikas Publishing House. 2. Saikia, B. (Year). <i>Organic chemistry-I with practical..</i> 3. Agrawal, O. P. (Year). <i>Advanced practical organic chemistry</i> . Krishna Publication. | | |
| Online Resources: | | |
| https://www.organic-chemistry.org/synthesis/ https://www.orgsyn.org/ https://vlab.amrita.edu/?sub=2&brch=191&sim=344&cnt=1#:~:text=In%20order%20to%20detect%20them,detected%20by%20simple%20chemical%20tests. | | |
| PART-D: Assessment and Evaluation | | |
| Suggested Continuous Evaluation Methods: | | |
| Maximum Marks: 50 Marks | | |
| Continuous Internal Assessment (CIA): 15 Marks | | |
| End Semester Exam (ESE): 35 Marks | | |
| Continuous Internal Assessment (CIA): (By Course Teacher) | Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar + Attendance - 05 Total Marks - 15 | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks |
| End Semester Exam (ESE): | Laboratory / Field Skill Performance: On spot Assessment M. Performed the Task based on lab. work - 20 Marks N. Spotting based on tools & technology (written) - 10 Marks O. Viva-voce (based on principle/technology) - 05 Marks | Managed by Course teacher as per lab. status |

Name and Signature of Convener & Members of CBoS:

Indira

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

| PART- A: Introduction | | | |
|--|--|---|--|
| Program: Bachelor in Science (Degree/Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | CHSE-06T | |
| 2 | Course Title | SPECTROSCOPY-I | |
| 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"> ➤ To equips students with advanced spectroscopic techniques for in-depth molecular analysis. ➤ To enable classification, isotope effect analysis, and vibrational energy calculations of techniques like microwave and infrared spectroscopy ➤ To provide detailed information on structure, environment, and electronic configuration on advanced methods like NMR, NQR, and PES. ➤ To allows students to probe chemical and surface properties of materials using Photoacoustic spectroscopy. ➤ | |
| 6 | Credit Value | 3 Credits | Credit = 15 Hours - learning & Observation |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | Molecular Spectroscopy Energy levels, molecular orbital, vibronic transitions, vibration progressions and geometry of the excited states, Franck - Condon principle, electronic spectra of polyatomic molecules. Emission spectra: radiative and non-radiative decay, internal conversion, spectra of transition metal complex, charge transfer spectra. Microwave Spectroscopy Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications. | | 12 |
| II | Infrared spectroscopy Review of linear harmonic oscillator, vibrational energy of diatomic molecules, zero point energy, force constant and bond strengths, anharmonicity. Morse potential energy diagram, vibration – rotation Spectroscopy, P, Q, R branches. Breakdown of Oppenheimer approximation, vibration of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis. Raman Spectroscopy Classical and quantum theories of Raman effect – Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman Spectroscopy, coherent anti stokes Raman Spectroscopy (CARS) | | 11 |
| III | Nuclear Magnetic Resonance Spectroscopy Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, | | 11 |

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|-----------------|--|----|
| | <p>deshielding, spin-spin interactions, factors including coupling constant 'J'. Classification (ABX, AMX, ABC, AB etc), spin decoupling. Basic ideas about instruments, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics.</p> <p>Nuclear Quadrupole Resonance Spectroscopy Quadrupole nuclei, Quadrupole moments, electric field gradient, coupling constant, splitting, applications.</p> | |
| IV | <p>Photoelectron Spectroscopy Basic principle: photo-electric effect, ionization process, Koopmans theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA.</p> <p>Photo acoustic Spectroscopy Basic principles of photo acoustic spectroscopy (PAS), PAS gases and condensed systems, chemical and surface applications.</p> <p>Electron Spin Resonance Spectroscopy Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.</p> | 11 |
| Keywords | <p><i>Electronic Transitions, Emission Spectra, Isotope Effect, Vibrational Energies, Raman Spectroscopy, Nuclear Magnetic Resonance (NMR), Nuclear Quadrupole Resonance (NQR), Photoelectron Spectroscopy (PES), Photoacoustic Spectroscopy (PAS), Molecular Structure</i></p> | |

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Muthu, K. S. (2010). *Applications of spectroscopy*. Medtech Publications.
2. Ambika, Dr., & Singh, P. P. (2017). *Organic spectroscopy*. Viva Books.

References Books Recommended –

1. Hollas, J. M. (2019). *Modern Spectroscopy* (John Wiley & Sons).
2. *Applied Electron Spectroscopy For Chemical Analysis* (Wiley-Interscience).
3. Parish, R. V. (1983). *NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry* (Ellis Horwood).
4. Drago, R. S. (1977). *Physical Methods in Chemistry* (Saunders Company).
5. Nakamoto, K. (2009). *Infrared and Raman Spectra: Inorganic and Coordination Compounds* (Wiley).
6. Williams, D. H., & Fleming, I. (2010). *Spectroscopic Methods in Organic Chemistry* (Tata Mcgraw-Hill).
7. Dyer, J. R. (1975). *Application of Spectroscopy of Organic Compounds* (Prentice Hall).

Online Resources–

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

Online Resources–

- (<https://archive.nptel.ac.in/courses/104/106/104106122/>)
- (<https://m.youtube.com/watch?v=o8zELwp358A>)
- (<https://archive.nptel.ac.in/courses/103/108/103108139/>)
- (<https://nptel.ac.in/courses/104108078>)

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

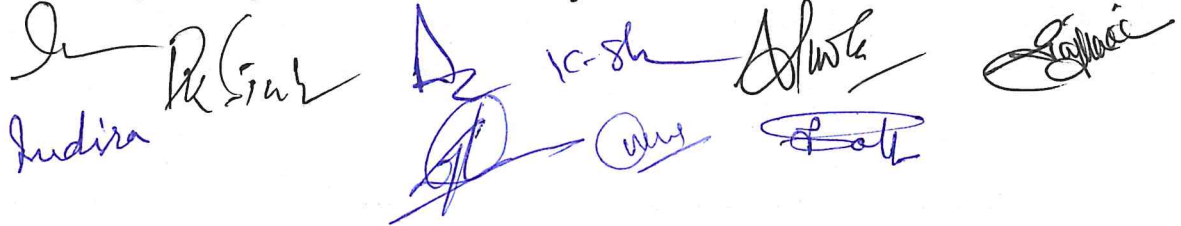
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener & Members of CBoS:



 The image shows several handwritten signatures in blue ink. On the left, there is a signature that appears to be 'Indira'. To its right are several other signatures, some of which are more stylized and difficult to decipher, but they appear to be names of individuals.

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

| PART- A: Introduction | | | |
|---|--------------------------------|---|--|
| Program: Bachelor in Science (Certificate / Diploma / Degree/Honors) | | Semester - VII | Session: 2027-2028 |
| 1 | Course Code | CHSE-06P | |
| 2 | Course Title | SPECTROSCOPY-I LAB. COURSE | |
| 3 | Course Type | DSE | |
| 4 | Pre-requisite (if, any) | As per Program | |
| 5 | Course Learning Outcomes (CLO) | <ul style="list-style-type: none"> ➤ Understand the fundamental principles of different spectroscopic techniques (Microwave, Infrared, Raman, NMR, UV-Vis (optional) and interpret the data obtained from various spectroscopic experiments. ➤ Relate the observed spectroscopic features to the structure, bonding, and dynamics of molecules. ➤ Develop practical skills in operating spectroscopic instrumentation and analyzing data. ➤ Enhance critical thinking and problem-solving skills in a laboratory setting. | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |

PART -B: Content of the Course

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

| Module | Topics (Course contents) | No. of Period |
|---|---|---------------|
| Lab./Field Training/Experiment Contents of Course | <p>Rotational Spectroscopy of a Diatomic Molecule (Microwave Spectroscopy): Analyze the rotational spectrum of simple molecules and calculate its moment of inertia.</p> <p>Infrared (IR) Spectroscopy of a Simple Molecule: Record and interpret the IR spectrum of a molecule, identifying functional groups based on characteristic frequencies.</p> <p>Raman Spectroscopy of a Liquid Sample: Compare the Raman spectrum of a liquid to its IR spectrum and explore the concept of mutual exclusion principle.</p> <p>Nuclear Magnetic Resonance (NMR) Spectroscopy of Simple Molecules: Analyze the ¹H NMR spectrum of simple organic molecule, understanding the effects of chemical environment and spin-spin coupling.</p> <p>(Ultraviolet-Visible (UV-Vis) Spectroscopy of a Conjugated System: Concentration Determination of Using Lambert Beer's Law, measurement of the UV-Vis spectrum of a chromophore-containing molecule (e.g., conjugated diene, transition metal complex) and analyze the observed absorption bands based on their λ_{max} (wavelength of maximum absorption) values, Investigate the electronic transitions of a conjugated molecules (polyenes and conjugated carbonyls) using UV-Vis spectroscopy, study the formation of a colored complex in a complexation reaction, Calculation of the equilibrium constant using Beer's Law and relevant equations.</p> <p>ESR: Common examples include studying free radicals generated during chemical reactions or analyzing organic radicals in biological systems.</p> | 30 |

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|-----------------|--|
| Keywords | <i>Electronic Transitions, Emission Spectra, Raman Spectroscopy, Nuclear Magnetic Resonance (NMR), Electron Spin Spectroscopy (ESR), UV-Visible Spectroscopy</i> |
|-----------------|--|

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Mukherjee, P. S. (2009). *Electronic Absorption Spectroscopy and Related Techniques* (1st Ed.). New Age International (Publishers).
2. Sharma, Y. R. (2007). *Elementary organic spectroscopy* (Reprint). S. Chand Publishing.
3. Yadav, D. S. (2004). *Organic spectroscopy*. [Kindle Edition]. doi: 10.1007/978-1-4020-2575-4

Reference Books:

1. Smith, R. A. (1974). *Infrared and Raman Spectra of Inorganic Compounds*. CRC Press.
1. Abraham, R. J., & Settle, F. A. (2011). *Interpreting NMR Spectra*. Wiley-Blackwell.
2. Jaffe, H. H., & Orchin, M. (1962). *UV-Vis Spectral Library of Common Organic Molecules*. Prentice-Hall.
3. Carnevale, A., & Piacenti, P. (2017). *Experimental Techniques in Nuclear Magnetic Resonance Spectroscopy*. Royal Society of Chemistry.
4. Chalmers, J. M., & Griffiths, P. R. (2002). *Handbook of Vibrational Spectroscopy*. John Wiley & Sons, Ltd.

Online Resources–

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

- (<https://www.nist.gov/>)
- (<https://edu.rsc.org/resources/spectroscopy-videos/1041.article>)
- (<https://acsanalytical.org/>)
- (<https://nscl.msu.edu/>)
- (<https://new.nsf.gov/funding/opportunities/nsf-national-quantum-virtual-laboratory-nqvl>)
- (<https://www.chemtube3d.com/sym-operationsrotations/>)

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 | |
| | P. Performed the Task based on lab. work | - 20 Marks |
| | Q. Spotting based on tools & technology (written) – 10 | Marks |
| | R. Viva-voce (based on principle/technology) | - 05 Marks |
| | | Managed by Course teacher as per lab. status |

Name and Signature of Convener & Members of CBoS:

Indira Kumar, Dr. R. Sharma, Anurag Raj, [Signature]

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

| PART-A: Introduction | | | |
|--|------------------------------|---|---|
| Program: Bachelors in Science <i>(Honors/Honors with Research)</i> | | Semester-VII | |
| | | Session:2024-25 | |
| 1 | CourseCode | CHSE-07T | |
| 2 | CourseTitle | CHEMICAL KINETICS AND NUCLEAR CHEMISTRY | |
| 3 | CourseType | DSE | |
| 4 | Pre-requisite(if,any) | <i>As per Program</i> | |
| 5 | CourseLearning Outcomes(CLO) | <ul style="list-style-type: none"> ➤ <i>To understand types/kinetics of composite reactions and elucidate mechanism and derive rate laws, calculate various activation parameters and predict feasibility of reaction of its basis.</i> ➤ <i>To explain the concept of acidity functions and illustrate the various rate correlations, isotopic effect and solvent effect.</i> ➤ <i>To discuss various aspects of nuclear models, nuclear reactions and nuclear reactors.</i> ➤ <i>To understand the principles of radioactivity, its measurements, counters, apply in determining reaction mechanism, structures, physicochemical properties and in chemical analysis.</i> | |
| 6 | CreditValue | 03Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | TotalMarks | Max.Marks:100 | MinPassingMarks:40 |

PART-B: Content of the Course
TotalNo.of Teaching-learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

| Unit | Topics(Coursecontents) | No.of Period |
|-----------|---|--------------|
| I | <p>Kinetics of CompositeReactions Types of composite mechanism, rate equation for composite mechanisms- simultaneous and consecutive reactions, microscopic reversibility, some inorganic mechanisms- formation and decomposition of phosgene, decomposition of nitrogen pentoxide and ozone and thermal para-ortho hydrogen conversion.</p> <p>Kinetics of Catalytic Reactions Kinetics of acid-base catalysis: general and specific, hydrolysis of ester and amide; Enzyme catalysis, Micellar catalysis.</p> <p>Activation Parameters Activation parameters from experimental results- Arrhenius factor, standard free energy of activation, standard enthalpy of activation, entropy of activation and their physical significance.</p> | 12 |
| II | <p>Acidity function and various rate correlations Hammett acidity function, various treatments of rate correlation, Linear Free Energy Relationship (LFER), The Hammett equation, Zucker-Hammett-hypothesis, Bunnett-Olsen parameter.</p> <p>Isotopic Effect Theory of isotopic effects; Primary and secondary kinetic isotope effects. Heavy atom isotope effects, Tunneling effect. Kinetic solventeffects.</p> <p>Solvent Effect Qualitative theory of influence of solvent on reaction rate; Solvent effect in terms of dielectric constant, Grunwald - Weinstein parameter, Z and E values. Application of solvent polarity, Koppel - Palm-treatment.</p> | 11 |

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|-----------------|---|-----------|
| III | <p>Nuclear Models Shell model – magic numbers, salient features and merits; liquid drop model – analogy with liquid drop, merits, semi-empirical equation; Fermi gas model; collective model and optical model.</p> <p>Nuclear Reactions Nuclear fusion and fission; Nuclear fission – mass, energy and charge distribution of fission products; fission neutrons; liquid drop model.</p> <p>Nuclear Reactors Natural uranium reactors, classification of reactors – typical reactors, Breeder reactor.</p> | 11 |
| IV | <p>Radioactivity General characteristics of radioactive decay and decay kinetics, measurement of radioactivity: Ionization chamber, electron pulse counters – variation of pulse size with voltage, Geiger-Muller counter, proportional counter and scintillation counters.</p> <p>Applications of Radioactivity Typical applications of radioisotopes as tracers; chemical investigation – reaction mechanism and structure determination; physicochemical applications – solubility of sparingly soluble and surface area of a powder; analytical applications – isotope dilution analysis and neutron activation analysis; age determination and medical applications.</p> | 11 |
| <i>Keywords</i> | <i>Kinetics, composite reactions, catalytic reactions, activation parameters, acidity function, isotopic effect, nuclear models, radioactivity.</i> | |

Signature of Convener & Members (CBoS):

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| PART-C |
| Learning Resources: Textbooks, Reference Books and Others |
| <p>Textbooks Recommended– 1. Arnikar, H. J. (1995). <i>Essentials of nuclear chemistry</i> (No. 1653). New Age International.</p> <p>Reference Books Recommended–</p> <ol style="list-style-type: none"> Laidler, K. J., & Keith, J. (1965). <i>Chemical kinetics</i> (Vol. 2). New York: McGraw-Hill. Chorkendorff, I., & Niemantsverdriet, J. W. (2017). <i>Concepts of modern catalysis and kinetics</i>. John Wiley & Sons. Vannice, M. A., & Joyce, W. H. (2005). <i>Kinetics of catalytic reactions</i> (Vol. 134). New York: Springer. Investigation of Reduction Rates and Mechanism of Reactions. Edward Lewis. |
| <p>Online Resources – e-Resources/e-books and e-learning portals</p> <ul style="list-style-type: none"> ➤ https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry - The Central Science (Brown et al.)/14%3A_Chemical Kinetics/14.S%3A_Chemical Kinetics (Summary) ➤ https://www.vssut.ac.in/lecture_notes/lecture1425072667.pdf ➤ https://www.khanacademy.org/science/chemistry/chem-kinetics/arrhenius-equation/a/types-of-catalysts ➤ https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/ ➤ https://www.orano.group/en/unpacking-nuclear/all-about-radioactivity |

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

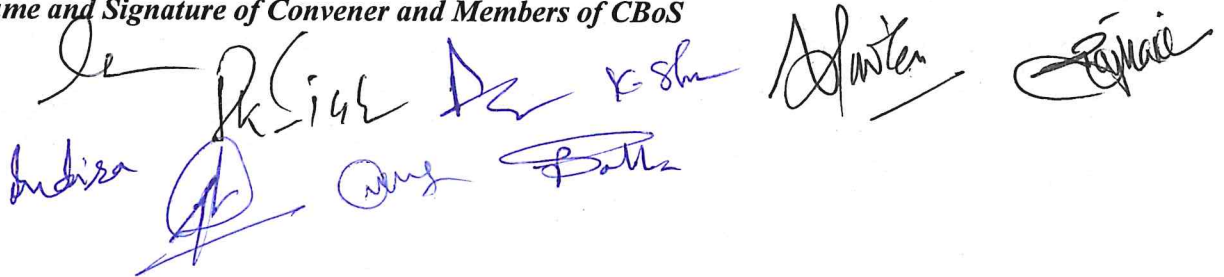
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener and Members of CBoS



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

| PART- A: Introduction | | | |
|--|-------------------------------|---|---|
| Program: Bachelor in Science (Honors/ Honors with Research) | | Semester - VII | |
| Session: 2024-2025 | | | |
| 1 | CourseCode | CHSE-07P | |
| 2 | CourseTitle | CHEMICAL KINETICS AND NUCLEAR CHEMISTRY LAB. COURSE. | |
| 3 | CourseType | DSE | |
| 4 | Pre-requisite(if,any) | As per Program | |
| 5 | Course Learning Outcomes(CLO) | <ul style="list-style-type: none"> ➤ To understand basic concepts in Physical Chemistry through experiential learning. ➤ To acquaint with the basic principles of equipment/instruments and its applications. ➤ To determine the order of reaction with respect to various reactants and overall order and activation parameters using experimental data. ➤ To acquire the knowledge of radioactive decay and GM counter. | |
| 6 | Credit Value | 01Credit | (Credit = 30 Hrs laboratory or Field learning / training) |
| 7 | Total Marks | Max.Marks:50 | MinPassingMarks:20 |

PART -B: Content of the Course

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

| Module | Topics(Course contents) | No. of Period |
|--|--|---------------|
| Lab./Field Training/ Experiment Contents of Course | <p>Chemical Kinetics</p> <ol style="list-style-type: none"> 1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions. 2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction. <p>Polarimetry</p> <ol style="list-style-type: none"> 1. Determine the specific and molecular rotation of optically active substance. 2. To determine the concentration of a solution of an optically active substance. <p>Viscosity</p> <ol style="list-style-type: none"> 1. To determine viscosity of an organic liquid using Ostwald viscometer. 2. To verify Kendall's equation. 3. To study the variation of viscosity with temperature. <ol style="list-style-type: none"> 1. To study the effect of concentration of the reactant and catalysts on the rate of hydrolysis of ester. 2. To study the effect of temperature, concentration of the reactant and catalysts on the rate of hydrolysis of ester and to calculate energy of activation, frequency factor, enthalpy of activation, entropy of activation and free energy of activation. | 30 |

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| | <ol style="list-style-type: none"> 3. To study the kinetics of saponification of ethyl acetate by (a) Volumetric method (b) Conductometric method 4. To study the influence of ionic strength on the reaction between potassium persulphate and iodide. 5. To study the Kinetics of reaction between H₂O₂ and KI. 6. To study the kinetics of reaction between sodium formate and iodine. 7. To study the kinetics of reaction between acetone and iodine. 8. To determine the rate constant of hydrolysis / inversion of sugar using polarimeter and factors effecting. 9. To study some simple enzyme catalysed reaction. 10. To determine plateau and optimal operating voltage of Geiger-Muller counter. 1. To determine the dead time or resolving time of GM counter. 2. Simulation of Radioactive decay using rolling of dice. | |
| Keywords | <i>Chemical Kinetics, nuclear chemistry, Activation energy, GM counter, Decay kinetics</i> | |

Signature of Convener & Members (CBoS):

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| PART-C |
| Learning Resources: Text Books, Reference Books and Others |
| <p>Textbook Recommended-</p> <ol style="list-style-type: none"> 1. Athawale, V. D., & Oza, N. R. (2001). <i>Experimental physical chemistry</i>. New Age International Publishers. 2. Bahl, B. S., Bahl, A., & Tuli, G. D. (2018). <i>Essentials of physical chemistry (Vol. 2: Practical physical chemistry)</i>. S. Chand Publishing. <p>Reference Books Recommended</p> <ol style="list-style-type: none"> 1. Friedlander, G., Kennedy, J. W., Miller, J. M., Seaborg, G. T., & Nuclear Regulatory Commission. (2014). <i>Radiochemistry and nuclear chemistry (Vol. 2: Practical radiochemistry)</i>. |
| <p>Online Resources-</p> <p>https://www.mdpi.com/books/reprint/4856-synthesis-and-characterization-of-nanomaterials https://swayam.gov.in https://epathshala.nic.in http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000803.html</p> |

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| PART -D: Assessment and Evaluation | | |
| Suggested Continuous Evaluation Methods: | | |
| Maximum Marks: 50 Marks | | |
| Continuous Internal Assessment (CIA): 15 Marks | | |
| End Semester Exam (ESE): 35 Marks | | |
| Continuous Internal Assessment (CIA): (By Course Teacher) | Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar + Attendance - 05 Total Marks - 15 | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks |
| End Semester Exam (ESE): | Laboratory/Field Skill Performance : on spot Assessment A: Perform task Based on the lab work- 20 Mark B: Spotting Based on tools and techniques- 10 marks C: Viva-voce (Based on principle/technology)-05 Marks | Managed by Course teacher as per Lab. Status. |

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF CHEMISTRY

COURSE CURRICULUM

| PART-A: Introduction | | | |
|--|---|--|---|
| Program: Bachelors in Science <i>(Certificate/Diploma /Degree/Honors)</i> | | Semester-VII | Session:2024-2025 |
| 1 | CourseCode | CHSE-08T | |
| 2 | CourseTitle | ELECTRO CHEMISTRY & SURFACE CHEMISTRY | |
| 3 | CourseType | DSE | |
| 4 | Pre-requisite(if,any) | <i>As per Program</i> | |
| 5 | CourseLearning Outcomes(CLO) | <ul style="list-style-type: none"> ➤ <i>Understand electrochemistry fundamentals, explain laws and industrial applications</i> ➤ <i>To explain and derive equations related to the theory of strong electrolytes – Debye-Huckel law and its extensions, structure/models and thermodynamics of electrified interfaces, polarography and its applications.</i> ➤ <i>To describe and interpret various adsorption isotherms and its applications, concept and various aspects of micelles.</i> ➤ <i>To understand the fundamentals, types, and applications of surfactants and micelles.</i> | |
| 6 | CreditValue | 03Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | TotalMarks | Max.Marks:100 | MinPassingMarks:40 |
| PART-B: Content of the Course | | | |
| TotalNo.of Teaching-learning Periods(01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Module /Unit | Topics(Coursecontents) | | No.of Period |
| I | Electrochemistry-1 Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law indetermination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage. | | 12 |
| II | Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's(DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and movingboundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG , ΔH and ΔS for cell reaction. | | 11 |
| III | Electrochemistry-2 Electrochemistry of solutions: Ion- solvent interactions, Debye-Huckel theory for activity coefficient of electrolyte solutions, ionic strength, Debye-Huckel limiting law, Debye- Huckel- Onsager treatment and its extension. Thermodynamics of electrified interface equations: Derivation of electro-capillarity, Lippmann equations, determination of surface excess. Structure of electrified interfaces: Guoy-Chapman and Stern models. Over | | 11 |

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| | potentials, exchange current density, derivation of Butler-Volmer equation. Tafel plot. Polarography theory - Ilkovic equation, half wave potential and its significance. | |
| IV | Surface Chemistry Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BET equation. Micelles Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles. | 11 |
| Keywords | <i>Electrochemistry, Kohlrausch law, electrode potential, standard electrode potential, electrochemical series, Debye-Huckel limiting law, surface chemistry, micelles, adsorption.</i> | |

Signature of Convener & Members (CBoS):

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| PART-C | |
| Learning Resources: Textbooks, Reference Books and Others | |
| Textbooks Recommended- | |
| 1. Soni, P. L., & Mahajan, S. N. (2013). A textbook of physical chemistry (Vol. 3: Electrochemistry and surface chemistry). Sultan Chand & Sons. 2. Rakshit, P. C. (2009). A textbook of physical chemistry (Vol. 2: States of matter). Tata McGraw-Hill Education. | |
| Reference Books Recommended- | |
| 1. Moroi, Y. (2013). <i>Micelles: theoretical and applied aspects</i> . Springer Science & Business Media. 2. Glasstone, S. (2011). <i>An introduction to electrochemistry</i> . Read Books Ltd. 3. Plieth, W. (2008). <i>Electrochemistry for materials science</i> . Elsevier. 4. Bikerman, J. J. (2013). <i>Surface chemistry: theory and applications</i> . Elsevier. 5. Somorjai, G. A., & Li, Y. (2010). <i>Introduction to surface chemistry and catalysis</i> . John Wiley & Sons. | |
| Online Resources - e-Resources/e-books and e-learning portals | |
| <ul style="list-style-type: none"> • https://ceramrtr.ceramika.agh.edu.pl/~szyszkin/eis/Modern%20Electrochemistry%20Vol%20B%20Electrode%20in%20Chemistry,%20Engineering.pdf • https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCYA5303.pdf • https://www.genesis-tutorials.com/wp-content/uploads/2018/04/Surface-chemistry.pdf • https://study.com/academy/lesson/micelles-biology-structure-function.html | |

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

Name and Signature of Convener and Members of CBoS

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

| PART- A: Introduction | | | |
|--|--|--|--|
| Program: Bachelor in Science (Honors/Honors with Research) | | Semester - VII | Session: 2024-2025 |
| 1 | CourseCode | CHSE-10P | |
| 2 | CourseTitle | NANOTECHNOLOGY AND SOLID STATE LAB. COURSE | |
| 3 | CourseType | DSE | |
| 4 | Pre-requisite(if,any) | As per Program | |
| 5 | CourseLearning.O utcomes(CLO) | <ul style="list-style-type: none"> ➤ The consolidation of knowledge about the structure-property relationship of solids through the self-directed synthesis, structure and property determination ➤ To apply the knowledge gained on the synthesis, structure and function of solid-state compounds. ➤ To acquire knowledge to synthesize nanomaterials and interpret its characteristics. ➤ To acquire the knowledge of basic sciences required to understand the fundamentals of nanomaterials | |
| 6 | CreditValue | 01Credit (Practical) | (Credit = 30Hrs laboratory or Field learning / training) |
| 7 | TotalMarks | Max.Marks:50 | MinPassingMarks:20 |
| PART-B: Content oftheCourse | | | |
| TotalNo.ofTraining/performancePeriods (01Hr.perperiod)(30 Period 30hours) | | | |
| Module | Topics(Coursecontents) | | No.of Period |
| Lab./Field Training/ Experiment Contents of Course | Preparation of several solid-state compounds using different synthesis methods Characterization of the compounds by FTIR and X-ray diffraction Analysis of the crystal structures and the properties of the prepared solids Synthesis and characterization of nanoparticle of Fe ₃ O ₄ by chemical method. Synthesis of graphene oxide from graphene by chemical methods. Synthesis of graphene oxide from graphene by green methods. Synthesis and characterization of Ag nano-particles by green method. Synthesis and characterization of Ag nano-particles by chemical method. Synthesis and characterization of Cu nano-particles by green method. Synthesis and characterization of Cu nano-particles by chemical method. Synthesis and characterization of Ni nano-particles by chemical method. Synthesis and characterization of Ni nano-particles by green method Microwave synthesis of materials. organic compounds. The Nano World. Nanomaterials and Their Synthesis. Characterization Methods for Studying Nanomaterials. Laboratory Safety and Scientific Report Writing. | | 30 |
| Keywords | X-ray Diffraction; Microwave Synthesis, Nanomaterials, Characterization, Green Methods. | | |

Signature of Convener & Members (CBoS):

PART-C**Learning Resources: Text Books, Reference Books and Others****TextBooks Recommended-**

1. Venkatraman, D., Mukhopadhyay, C., & Das, K. (2018). *Introduction to nanoscience and nanomaterials*. McGraw-Hill Education.
2. Byrappa, K., & Yoshimura, M. (2010). *Functional nanomaterials and devices*. Elsevier.
3. Kumar, S. (2018). *Green chemistry for sustainable development*. Springer Nature Singapore Pte Ltd.

Reference Books Recommended-

1. Rao, C. N. R., Müller, A., & Cheetham, A. K. (2007). *Nanomaterials chemistry*. Wiley-VCH.
2. Chakravarty, A., & Singh, P. (2024). *Green synthesis of nanomaterials: Biological and environmental applications*. Wiley.
3. Sharon, M. (2018). *Green processes and sustainable chemistry*. Springer Nature Singapore Pte Ltd.
4. Anastas, P. T., & Warner, J. C. (1998). *Green chemistry: Theory and applications*. Oxford University Press.

OnlineResources-

- <https://www.mdpi.com/books/reprint/4856-synthesis-and-characterization-of-nanomaterials>
- <https://swayam.gov.in>
- <https://epathshala.nic.in>
- <http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000803.html>

Web Resources :-

Not Voodoo

The Safety Net

Comp Chem Website

PART -D: Assessment and Evaluation**Suggested Continuous Evaluation Methods:****Maximum Marks:** 100 Marks**Continuous Internal Assessment (CIA):** 30 Marks**End Semester Exam (ESE):** 70 Marks

| | | |
|--|---|---|
| Continuous Internal Assessment (CIA): (By Course Teacher) | Internal Test / Quiz-(2): 20 / 20 | 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 & Members of CBoS:

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

| PART- A: Introduction | | | |
|--|--|--|---|
| Program: Bachelor in Life Sciences <i>(Honors)</i> | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSC- 07 T | |
| 2 | Course Title | Ecology and Phytogeography | |
| 3 | Course Type | Discipline Specific course (DSC) | |
| 4 | Pre-requisite (if, any) | <i>As per program</i> | |
| 5 | Course Learning Outcomes (CLO) | At the end of this course, students will be able to understand: <ul style="list-style-type: none"> ▪ The interrelationship between organisms and environment. ▪ Methods to study vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. ▪ Evolving strategies for sustainable natural resource management and biodiversity conservation. ▪ Climatic changes and its restoration ▪ Familiar with sustainable development | |
| 6 | Credit Value | 3 Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | Ecological Factors and Management : Climatic- light; temperature, air and water, topographic, edaphic, soil formation soil texture, type of soil, soil profile, classification, physio-chemical properties, soil organic matter, biotic factors, interrelationships, major soil type of the world. Ecological management: Concepts, sustainable development, sustainability indicators. | | 12 |
| II | . Ecosystem Organization : Structure and function, primary production (methods of measurements, global pattern, controlling factors), energy dynamics, trophic organization, energy flow pathways, ecological efficiencies, litter fall and decomposition- mechanism, substrate quality and climate factors, global biogeochemical cycle of C, N, P, S, minerals cycle- pathways, processes, budgets in terrestrial and aquatic ecosystem. | | 11 |
| III | Community and Eco-Stability Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, inter-specific associations, ordination, concept of ecological niche. Vegetation Development: Temporal changes (cyclic and non-cyclic), mechanism of ecological successions (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), changes in ecosystem properties during succession. Ecological Stability: Concept of resistance and resilience, ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystem, ecology of plant invasion, environmental impact assessment, ecosystem restoration. | | 11 |
| IV | Phytogeography Pollution, Climatic Changes Phytogeographical regions of India with reference to Chhattisgarh. Pollution : Air, Water, Soil & Sound - kinds, sources, quality parameters, effect on plans and ecosystem. Climate change: Green house gases(CO ₂ , CH ₄ , N ₂ O, CFCs) sources, trends and role, ozone layer and ozone hole, consequences of climate changes, (CO ₂ fertilization, global warming, sea level rise, UV radiation). | | 11 |
| <i>Keywords</i> | Ecological Factors community and continuum ecosystem ,Phytogeographical ,climate changes | | |
| Signature of Convener & Members (CBoS) : | | | |
| <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <ol style="list-style-type: none"> 1. <i>[Signature]</i> 2. <i>[Signature]</i> 3. <i>[Signature]</i> 4. <i>[Signature]</i> 5. <i>[Signature]</i> </div> <div style="width: 45%;"> <ol style="list-style-type: none"> 6. <i>[Signature]</i> 7. <i>[Signature]</i> 8. <i>[Signature]</i> 9. <i>[Signature]</i> 10. <i>[Signature]</i> </div> </div> | | | |

Ecological factors & Management

Ecosystem organisation

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Brady, N. C. (1990) The Nature and Properties of Soil Macmillan, Sydney, Australia.
2. Begon, M; Harper, J. L. And Townsend, C. R. (1996) Ecology. Blackwell Science, Cambridge, USA
3. Chapman, J. L. and Raiss, M. J. (1988) Ecology: Principles and Applications. Cambridge Univ. Press, Cambridge, U.K.
4. Kumar, H. D. (1986) Modern Concept of Ecology, Vikas Publishing House Private Ltd., New Delhi.

Reference books:

1. Hill, M. K. (1997) Understanding Environmental Pollution. Cambridge Univ. Press, Cambridge, U. K.
2. Odum, E. P. (1971) Fundamentals of Ecology. Saunders, Philadelphhia.
3. Odum, E. P. (1983) Basic Ecology. Saunders, Philasephia

Online Resources–

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

Online Resources–

- e-Resources / e-books and e-learning portals
- <https://courses.lumenlearning.com/wm-biology2/chapter/community-structure-and-dynamics/>
- <https://education.nationalgeographic.org/resource/ecosystem/>
- <https://www.embibe.com/exams/ecological-factors/>
- [https://www.sciencedirect.com/topics/earth-and-planetary-sciences/environmental-pollution#:~:text=Environmental%20pollution%20is%20unwarranted%20disposal,both%20quantitatively%20and%20qualitatively%20\(Hussain%2C](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/environmental-pollution#:~:text=Environmental%20pollution%20is%20unwarranted%20disposal,both%20quantitatively%20and%20qualitatively%20(Hussain%2C)
- https://onlinecourses.nptel.ac.in/noc24_ce03/preview
- https://onlinecourses.swayam2.ac.in/nou24_ge10/preview

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

| | | |
|--|--|---|
| Continuous Internal Assessment (CIA): 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 *Rajiv*
 ② *Rendu*
 ③ *Arjun*
 ④ *M. Srinivas*
 ⑤ *Arjun*
 ⑥ *[Signature]*
 ⑦ *[Signature]*
 ⑧ *[Signature]*
 ⑨ *[Signature]*
 ⑩ *[Signature]*

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

| PART- A: Introduction | | | |
|---|--|--|--|
| Program: Bachelor in Life Sciences (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSC-07 | |
| 2 | Course Title | Lab. Course – 07 (Ecology and Phytogeography) | |
| 3 | Course Type | Laboratory course | |
| 4 | Pre-requisite (if, any) | As per program | |
| 5 | Course Learning Outcomes (CLO) | <ul style="list-style-type: none"> ➤ Students will be able to determine frequency, abundance and density of any area. ➤ Learn community relationships of plants. ➤ Understand IVI and biomass. ➤ Can determine diversity indices. ➤ Biodiversity of different ecosystems ➤ Interaction among different community ➤ Pollution and its effect | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |
| PART -B: Content of the Course | | | |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | No. of Period | |
| Lab./Field Training/ Experiment Contents of Course | <ol style="list-style-type: none"> 1. to determine minimum size and number of quadrates required for reliable estimate of biomass in grass land ecosystem. 2. To study the frequency, abundance and density of plants in the local ecosystem by quadrat method. 3. To determine gross and net productivity by light and dark bottle method. 4. To determine soil moisture content, porosity and bulk density of soil collected from different locations. 5. To determine the water holding capacity of various soils. 6. To determine the basal cover, or vegetational cover of one herbaceous community by quadrat method. 7. To determine IVI of the grass land. 8. To measure the above-ground plant biomass in a grassland. 9. To determine diversity indices (richness, Simpson, Shannon-Wiener) in grazed and protected grassland. 10. Experiment on Physico-Chemical Analysis of Water (pH, Temperature, etc. 11. To determine transparency or turbidity of different water bodies. 12. To measure the amount of dissolved oxygen in pond water. 13. To determine the total dissolved solids (TDS) in water 14. To measure the amount of BOD in different types of water. 15. Ombrothermic diagram of your locality. | 30 | |
| Keywords | Quadrat, Productivity, Turbidity, TDS. | | |
| Signature of Convener & Members (CBoS) : | | | |

① R. P. Rao
 ② K. S. Rao
 ③ M. S. Rao
 ④ M. S. Rao
 ⑤ M. S. Rao
 ⑥ M. S. Rao
 ⑦ K. S. Rao
 ⑧ K. S. Rao
 ⑨ K. S. Rao
 ⑩ K. S. Rao

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bendre and Kumar, 2018. A text book of botany practical , Vol-2
2. Raj Mandeep, 2022. Principles of ecology .
3. Rao K S, 1993 Practical Ecology
4. Ashok K. Rathoure Bioremediation: Current Research and Applications .

Text Books Recommended –

1. Penny A. Cook, James R. Bell , C. Philip Wheeler , 2011. Practical Field Ecology: A Project Guide
2. D. D. Gilbertson , M. Kent , F. B. Pyatt, 1985. Practical Ecology for Geography and Biology
3. Masood, A.A. A text book of botany practical , Edn.-5
4. Gaurav Saxena Vineet Kumar and Maulin P. Shah . Bioremediation for Environmental Sustainability: Toxicity, Mechanisms of Contaminants Degradation, Detoxification and Challenges .

Online Resources–

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

Online Resources–

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

- <https://ecologicalprocesses.springeropen.com/articles/10.1186/s13717-022-00401-0>
- <https://www.internationalscholarsjournals.com/articles/applied-ecology-and-its-economical-applications-88784.html>
- <https://link.springer.com/book/10.1007/978-981-15-3372-3>
- <https://www.jstor.org/stable/2405009>
- <https://en.wikipedia.org/wiki/Bioremediation>
- <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/bioremediation>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5026719/>
- <https://www.ysi.com/parameters/turbidity>
- https://www.davidzeleny.net/wiki/doku.php/vegsurvey:materials:how_to_calculate_ivi

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 R. B. S. ...
 ② ...
 ③ ...
 ④ ...
 ⑤ ...
 ⑥ ...

⑦ ...
 ⑧ ...
 ⑨ ...
 ⑩ ...

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY COURSE CURRICULUM

| PART- A: Introduction | | | |
|--|---|--|---|
| Program: Bachelor in Life Science (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-05 T | |
| 2 | Course Title | Biosystematics and Biodiversity | |
| 3 | Course Type | Discipline Specific elective (DSE) | |
| 4 | Pre-requisite (if, any) | <i>As per program</i> | |
| 5 | Course Learning Outcomes (CLO) | <p><i>At the end of the course, the students will be able :</i></p> <ul style="list-style-type: none"> ➤ Understand different classification and nomenclature system in botany. ➤ Learn plant collection and preservation techniques . ➤ Get knowledge about the biodiversity and its importance. ➤ Analyse the different conservation practices for nature. | |
| 6 | Credit Value | 3 Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | No. of Period | |
| I | Definition and basic concepts of biosystematics taxonomy and classification. History and theories of biological Classification. Difference between botanical and zoological nomenclature system. Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy. Dimensions of speciation. | 12 | |
| II | Taxonomic procedures: Taxonomic collections, preservation, process of identification. Taxonomic keys, different types of keys, their merits and demerits. How to use flora, Species concepts: Typological, Nominalist and Biological species concepts. Subspecies and other infra-specific categories. | 11 | |
| III | Biodiversity : Concept and level, role of biodiversity in ecosystem, function and stability, speciation and extinction, IUCN categories of threat, distribution and global pattern, terrestrial biodiversity, hot spots. Plant biodiversity: Concept, status in India, utilization and concerns. | 11 | |
| IV | Principles of Conservation: <i>In-situ</i> conservation: Strategies for In situ conservation, international efforts and Indian initiatives, protected areas in Indian sanctuaries, national parks, biosphere reserves, wetland, mangroves and coral reefs for conservation of wild biodiversity. <i>Ex-situ</i> Conservation: Strategies for <i>Ex- situ</i> conservation, Principles and practices, Botanical gardens, gene bank, seed in vitro repositories, cryo banks. | 11 | |
| Keywords | Chemotaxonomy, Cladogram, Biodiversity, Conservation. | | |
| Signature of Convener & Members (CBoS) : | | | |

Biosystematics

Taxonomic Procedures

Biodiversity

Principles of conservation

① Rajeev

② Anand

③ Anurag

④ Anurag

⑤ Anurag

⑥ Anurag

⑦ Anurag

⑧ Anurag

⑨ Anurag

⑩ Anurag

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kochar, S. L. (1998) Economic Botany of The Tropics. McMillan India Ltd., New Delhi.
2. Paroda, R. S. and Arora R. K. (1991) Plant Genetic Resources and Conservation and Management IPGRI (publications). South Asia Office, c/o NBPGR, Pusa Campus, New Delhi.
3. Scheri, R. W. (1972) Plants for Man. Englewood Cliffs, New Jersey, Prentice Hall.
4. Anonymous (1997) National Gene Bank. Indian Heritage on Plant Genetic Resources (Booklet) NBPGER, New Delhi.
5. Swaminathan, M. S. And Kocchar (1989) Plants and Society, MacMillan Publication Ltd. London.
6. Kothari, A. (1997) Understanding Bio-Diversity: Life Sustainability and Equity. Orient Longam
7. Johri, B.M. (1984). Embryology of Angiosperms. Springer-Verlag, Berlin
8. Singh, G. (2012) Phant Systematics. Theory and Practice. Oxford & IBH Pvt. Ltd, New Delhi.
9. Bhojwani, SS. & Bhatnagar, SP (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Lid. New Delhi 5 edition
10. Mauseth. 1.1) (1988) Plant Anatomy. The Benjamin Cummings Publisher. USA
11. Pandey, B. P. (LatesEdt), Plant Anatomy
12. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
13. Saxena N.B. and Saxena S. (2012). Plant Taxonomy Pragati Prakashan.
14. Sharma O.P. (2013). Plant Taxonomy. MC GRAW HILL INDIA.
15. Sharma, M.K. (2013) Plant Structures (An Introduction to Plant Anatomy). VayuEducation of India.
16. Chopra G.L. (2005) Angiosperm, Pradeep Publication, Jalandhar.

Reference Books Recommended –

1. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
2. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York
3. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
4. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-APhylogenetic Approach. Sinauer Associates Inc., U.S.A. 2 nd edition.
5. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, San Diego, CA, USA
6. Beck, C.B. (2010). An Introduction to Plant Structure and Development, II edition.
7. Heywood, V. (1995) Global Bio-Diversity Assessment, UNEP. Cambridge Univ. Press, Cambridge, U.K.
8. Heywood, V.H. and Wyse Jackson, P. S. (1991) Tropical Botanical Garden: Their Role in Conservation and Development. Academic Press, San Digo.
9. Barker, H. G. (1978) Plant and Civilization. C. A. Wadsworth, Belmont.
10. Frankel, O. H., Brown, A. H. D. and Burdon, J. J., (1995) Conservation, of Plant Diversity. Cambridge Univ. Press, Cambridge, U. K.
11. Pinstrip- Anderson, P. Et Al (1999) World Food Prospects; Critical Issues for Early 21st Century. International Food Policy Research Institute, Washington D. C. USA.
12. Rogers, N. A. And Panwar, H. S. (1998) Planning A Wild Life Protected Area Network In India Vol. I The Report, Wildlife Institute Of India, Dehradun.

Online Resources–

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

- <https://www.sciencedirect.com/topics/social-sciences/natural-resource>
- <https://efaidnbmnnnibpcajpcgglefindmkaj/https://egyankosh.ac.in/bitstream/123456789/66166/2/Unit4.pdf>
- https://efaidnbmnnnibpcajpcgglefindmkaj/https://www.ers.usda.gov/webdocs/publications/41964/30289_biological.pdf?v=0#:~:text=16-What%20Are%20Biological%20Resources%3F,forests%2C%20and%20other%20natural%20lands.
- <http://surl.li/spcdd>
- <https://shorturl.at/ewyIP>
- <https://shorturl.at/cimoF>

Online Resources–

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

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

① Process
② lands
③ MS
④ MS

⑤ Appa
⑥ BL

⑦ pedin
⑧ bjig
⑨ MS
⑩ MS

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener & Members of CBoS:

- ① Riswan
- ② Arundh
- ③ Ms
- ④ [Signature]
- ⑤ Arundh
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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

| PART- A: Introduction | | | |
|--|--|--|---|
| Program: Bachelor in Life Science (Honours) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-05 P | |
| 2 | Course Title | Lab course -05 (Biosystematics and Biodiversity) | |
| 3 | Course Type | Laboratory course | |
| 4 | Pre-requisite (if, any) | As per program | |
| 5 | Course Learning Outcomes (CLO) | At the end of this course, students will be able to: > Understand collection and preservation techniques for plants. > Learn use of flora for plant identification. > Understand about protected area of the country > Analyze various IUCN categories of threats. | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |
| PART -B: Content of the Course | | | |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | | No. of Period |
| Lab./Field Training/ Experiment Contents of Course | <ul style="list-style-type: none"> • Herbarium technique. • Non destructive collection of plants • Preservation techniques for plants part . • Prepration of taxonomic keys • How to use flora and digital flora for plant identification. • Use of flora for identification of plants of college campus. • Cladogram and dendrogram • Visit of any botanical garden , national park/wildlife sanctuary/ protected area. • Learn about IUCN categories of threats. 1) Evaluation of alfa, beta and gama biodiversity of college campus.. | | 30 |
| Keywords | Herbarium, Flora, Protected area, IUCN categories. | | |
| Signature of Convener & Members (CBoS) : | | | |

- ① RBios
- ② Rencubg
- ③ Ruz
- ④ Ruz
- ⑤ Ruz
- ⑥ Ruz
- ⑦ Ruz
- ⑧ Ruz
- ⑨ Ruz
- ⑩ Ruz

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Kothari, A. (1997) Understanding Bio-Diversity: Life Sustainability and Equity. Orient Longman
2. Singh, G. (2012) Phant Systematics. Theory and Practice. Oxford & IBH Pvt. Ltd, New Delhi.
3. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.

Reference Books Recommended –

1. . flora of India by Botanical Survey of India
2. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2 nd edition.
3. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, San Diego, CA, USA

Online Resources–

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

- <https://www.worldfloraonline.org/>
- <https://bsi.gov.in/page/en/digital-resources>
- <https://indiaflora-ces.iisc.ac.in/FloraPeninsular/>
- <http://www.efloras.org/>
- <https://creately.com/guides/what-is-a-dichotomous-key/herpsteppp.inflibort.ac.in/Home/VirwSubject?catid=1pBOY7YTBC LSD2K>
- <https://eppp.inflibert.ac.in/Home/ViewSubjectPratid-100YJVTRCLSDKUBW>
- <https://www.inflibnet.ac.in/Home/ViewSubjectPratid-1pbbzy1BCS02E>
- <https://www.amazon.in/Plant-Taxonomy-past-present-future-chook/dp/B016021014>
- <https://www.instructables.com/How-to-Make-a-Cladogram/>
- [file:///C:/Users/user/Downloads/ajol-file-journals_452_articles_122070_submission_proof_122070-5365-335203-1-10-20150914%20\(1\).pdf](file:///C:/Users/user/Downloads/ajol-file-journals_452_articles_122070_submission_proof_122070-5365-335203-1-10-20150914%20(1).pdf)

Online Resources–

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

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

| | | |
|--|--|---|
| Continuous Internal Assessment (CIA): 15 (By Course Teacher) | Internal Test / Quiz-(2): 10 & 10 | 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 *R. Bhowmik*
- ② *R. Kundu*
- ③ *M. S.*
- ④ *S. K.*
- ⑤ *S. K.*
- ⑥ *A. K.*
- ⑦ *P. K.*
- ⑧ *S. K.*
- ⑨ *S. K.*
- ⑩ *M. S.*

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

| PART- A: Introduction | | | |
|--|---|---|--|
| Program: Bachelor in Life Science (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-06 T | |
| 2 | Course Title | Plant breeding and Seed 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 this course, the students will be able to > Gain knowledge and comprehension of the breeding systems > knowledge of reproductive biology in angiosperms to address real-world challenges related to plant breeding, crop production, and conservation. provide students with a comprehensive understanding of plant breeding principles and techniques. | |
| 6 | Credit Value | 3 Credits | Credit = 15 Hours - learning & Observation |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | Plant breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding. | | 12 |
| II | Methods of crop improvement: Introduction: Centers of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations. Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement. | | 11 |
| III | Breeding Methods for Stress Resistance: Breeding for drought, salinity, heat, cold, disease and insect resistance, breeding for protein and oil quality. Heterosis and inbreeding depression, hybrid and synthetic varieties. Hardy-Weinberg law, systems of mating. | | 11 |
| IV | Seed Technology: Principle & Concept of Seed Technology. Quality seeds, Indian seed act. Classes of quality seeds - breeder, foundation, registered and certified seeds, operations essential for seed production, seed processing, certification and maintenance storage of improved seeds, seed production organizations- national and state seed corporations and private seed companies. Artificial seeds, terminator seeds. | | 11 |
| Keywords Breeding, Heterosis, Self incompatibility, Hybridization. | | | |

Signature of Convener & Members (CBoS) :

①
 ②
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 ⑩

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Plant breeding by B.D Singh.
2. BD Singh (2003) Plant Breeding. Kalyani Publishers
3. PLANT BREEDING: PRINCIPLE AND METHODS B D SINGH - IN HINDI
4. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi.
5. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH.
6. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.
7. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.

Reference Books Recommended –

1. Allard (1960) Principles of Plant Breeding. John Wiley and Sons, Inc. New York.
2. Hayes, Immer and Smith (1955) Methods of Plant Breeding, MacGraw- Hill Book Co. Inc. New York.
3. Jonossy and Lupton (1976) Heatersis in Plant Breeding. Elsevier, Amsterdam.
4. Poehlman and Borthakur (1969) Breeding Asian Field Crops With Special Reference To Crops I India. Oxford and IBH Publishing Company, New Delhi.

Online Resources–

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

1. <https://chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://courseware.cutm.ac.in/wp-content/uploads/2020/05/Download-Notes-8.pdf>
2. <https://chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.eagri.org/eagri50/GBPR211/lec16.pdf>
3. <https://efaidnbmnnnibpcajpcglclefindmkaj/http://www.eagri.org/eagri50/GBPR211/lec16.pdf>
4. <https://www.sciencelearn.org.nz/resources/77-pollination-and-fertilisation>
5. <https://www.crops.org/about-crops/seed-technology#:~:text=What%20is%20seed%20technology%3F,that%20people%20and%20livestock%20eat.>
6. <https://plantbreeding2010.blogspot.com/2020/12/seed-and-seed-technology-introduction.html>
7. <https://www.nature.com/articles/s41477-018-0309-4>

Online Resources–

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

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

| | | |
|--|----------------------------------|---|
| Continuous Internal Assessment (CIA): 30 (By Course Teacher) | Internal Test / Quiz-(2): 20 +20 | 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. Singh
② S. K. Singh
③ M. Singh

④ S. K. Singh
⑤ S. K. Singh
⑥ S. K. Singh

⑦ S. K. Singh
⑧ S. K. Singh
⑨ S. K. Singh
⑩ S. K. Singh

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

| PART- A: Introduction | | | |
|---|--|---|--|
| Program: Bachelor in Life Science (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-06 P | |
| 2 | Course Title | Lab. Course- 06 (Plant breeding and Seed Technology) | |
| 3 | Course Type | Laboratory course | |
| 4 | Pre-requisite (if, any) | As per program | |
| 5 | Course Learning Outcomes (CLO) | At the end of the course students will be - > Idea of seeds which carries a new generation. > Knowledge of plant breeding techniques. > Knowledge of breeding methods for stress tolerance. > Idea of seed processing and certification of seeds. | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |
| PART -B: Content of the Course | | | |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | | No. of Period |
| Lab./Field Training/ Experiment Contents of Course | 1. Study of seed parts 2. Collection of different types of mature seeds 3. Techniques of hybridization- Emasculation. 4. Techniques of hybridization - Bagging and tagging. 5. Study of vegetatively grown plants part of your locality 6. Collection of seeds of different varieties of locally grown crops. 7. Inter-varietal cross in an ornamental plant. 8. Visit to state and national seed corporation companies and prepare a report. | | 30 |
| Keywords | Seed, Emasculation, Bagging and tagging. | | |

Signature of Convener & Members (CBoS) :

PART-C: Learning Resources

- ① Shiver
- ② Kando
- ③ Ms
- ④ [Signature]
- ⑤ [Signature]
- ⑥ [Signature]

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

| Text Books, Reference Books and Others | | |
|---|---|--|
| Text Books Recommended – | | |
| <ol style="list-style-type: none"> Allard (1960) Principles of Plant Breeding. John Wiley and Sons, Inc. New York. Hayes, Immer and Smith (1955) Methods of Plant Breeding, MacGraw- Hil Book Co. Inc. New York. Plant breeding by B.D Singh | | |
| Reference Books Recommended – | | |
| <ol style="list-style-type: none"> Jonossy and Lupton (1976) Heatersis in Plant Breeding. Elsevier, Amsterdam. Poehlman and Borthakur (1969) Breeding Asian Field Crops With Special Reference To Crops I India. Oxford and IBH Publishing Company, New Delhi. | | |
| Online Resources– | | |
| <ul style="list-style-type: none"> ➤ e-Resources / e-books and e-learning portals ➤ https://www.merriam-webster.com/dictionary/emasculate ➤ https://agritech.tnau.ac.in/crop_improvement/crop_imprv_emasculation_cereals.html ➤ https://www.toppr.com/guides/biology/reproduction-in-organisms/vegetative-propagation/#:~:text=Vegetative%20Propagation%20by%20Roots,example%2C%20Sweet%20potato%20and%20Dahlia. | | |
| Online Resources– | | |
| <ul style="list-style-type: none"> ➤ e-Resources / e-books and e-learning portals ➤ www.swayam.ac.in ➤ www.ignou.ac.in ➤ www.egyankosh.ac.in ➤ www.iitm.ac.in ➤ www.eskillindia.org ➤ www.eshiksha.mp.gov.in ➤ www.vlab.co.in ➤ www.internshala.com ➤ www.ndl.iitkgp.ac.in | | |
| PART -D: Assessment and Evaluation | | |
| Suggested Continuous Evaluation Methods: | | |
| Maximum Marks: | | 50 Marks |
| Continuous Internal Assessment (CIA): | | 15 Marks |
| End Semester Exam (ESE): | | 35 Marks |
| Continuous Internal Assessment (CIA): 15 (By Course Teacher) | Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15 | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks |
| End Semester Exam (ESE): 35 | Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks | Managed by Course teacher as per lab. status |

Name and Signature of Convener & Members of CBOS:

① Rishwan
② Anand
③ Ms. [Signature]
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**

| PART- A: Introduction | | | |
|--|---|---|--|
| Program: Bachelor in Life Science (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-07 T | |
| 2 | Course Title | Instrumentation and biochemical 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 this course, the students will be able to > Develop a solid understanding of different analytical methods and instruments used in plant sciences. > Acquire practical skills in sample preparation, data collection, and data analysis using analytical techniques. > Understand the working principles of important instrumentation tools. > Understand modern technologies in the field of Biochemistry | |
| 6 | Credit Value | 3 Credits | Credit = 15 Hours - learning & Observation |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | <ul style="list-style-type: none"> Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes in : (a) Flow cytometry (b) fluorescence microscopy: for Chromosome banding Phase contrast, electron, scanning and transmission electron microscopy, Single and double staining techniques for light microscopy for temporary and permanent slides Stain techniques: Single and double staining. | | 12 |
| II | Instruments: Salient features, Principle and applications. <ul style="list-style-type: none"> Autoclave, Oven, Laminar air flow, Centrifuge. Colorimetry Spectrophotometry, Fermenters., Water bath, pH meter | | 11 |
| III | <ul style="list-style-type: none"> Chromatography: Principle and its application in biological research: Paper chromatography, Column chromatography, Affinity chromatography, TLC, GLC, HPLC. Electrophoresis: AGE, PAGE, SDS-PAGE. Radioisotopes: Principles and its application in biological research. ELISA test | | 11 |
| IV | Biochemical Technology, Biofuel, CRISPR Technology Genetic Engineering, Vaccine, Biodegradable plastics Gene Therapy, DNA fingerprinting, GMO food, Pest resistant crops. | | 11 |
| Keywords | Microscope, biochemical technology | | |

Microscopy

Instrumentation

Chromatography & Advance Techniques

Biochemical Technology & Genetic Engineering

Signature of Convener & Members (CBs) :

① Ramesh
 ② Ramesh
 ③ Mr.
 ④
 ⑤
 ⑥
 ⑦
 ⑧
 ⑨
 ⑩

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Bioinstrumentation by L. VEERAKUMARI

Reference Books Recommended –

1. Biological Instrumentation & Methodology by Bajpai P. K.

Online Resources–

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

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2103.pdf
2. [https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ZOO/PK%20\(4\).pdf](https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ZOO/PK%20(4).pdf)
3. <https://kanchiuniv.ac.in/coursematerials/Biomedical%20instrumentation.pdf>

Online Resources–

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

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

| | | |
|---|--|---|
| Continuous Internal Assessment (CIA): 30 (By Course Teacher) | Internal Test / Quiz-(2): 20 +20 | 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., 1 out of 2 from each unit-4x10=40 Marks | |

Name and Signature of Convener & Members of CBoS:

① R. S. Rao

② K. S. Rao

③ M. S. Rao

④ S. S. Rao

⑤ S. S. Rao

⑥ S. S. Rao

⑦ S. S. Rao

⑧ S. S. Rao

⑨ S. S. Rao

⑩ S. S. Rao

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

| PART- A: Introduction | | | |
|---|--|--|--|
| Program: Bachelor in Life Science (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-07 P | |
| 2 | Course Title | Lab. course -07(Instrumentation and Biochemical Technology) | |
| 3 | Course Type | Laboratory course | |
| 4 | Pre-requisite (if, any) | As per program | |
| 5 | Course Learning Outcomes (CLO) | At the end of this course, the students will be able to get. > Knowledge about Bio Instruments. > Understand different parameters of instrumentation. > Operation and handling of latest equipments | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |
| PART -B: Content of the Course | | | |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | | No. of Period |
| Lab./Field Training/ Experiment Contents of Course | 1. Calibration of microscope. 2. Handling of microscope and other instruments. 3. Safety measures in laboratory 4. Principle and application of microscope 5. Principle and application of laboratory instruments-Autoclave, Oven, Laminar air flow, Centrifuge. Colorimetry and Spectrophotometry, Water bath, pH meter 6. Concept of pH and buffer formation 7. Separation of chlorophyll pigment by paper chromatography 8. Separation of chlorophyll pigment by thin layer chromatography (TLC) 9. Study of amino acid and calculation of Rf values by paper chromatography. 10. SDS -PAGE analysis of proteins 11. Quantitative analysis of DNA using colorimeter 12. Preparation of different types of solutions normal, molal and molar. 13. Visit to a nearby well equipped Scientific lab and prepare report. | | 30 |
| Keywords | microscope, pH, chromatography, solutions, Rf | | |

Signature of Convener & Members (CBoS) :

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

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

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Experiments In Microbiology, Plant Pathology And Biotechnology By K.R. Aneja. Publisher New Age International

Reference book recommended

1. Bioinstrumentation: Research, Development and Applications Hardcover Impert, 31 July 1990 by Donald L. Wise

Online Resources–

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

1. <https://www.lumentum.com/en/commercial-lasers/applications/biomedical-and-analytics-instrumentation>
2. <https://www.rgcb.res.in/instraining>
3. [https://admin/uploads/3/PG M.Sc. Botony 34631%20MICROBIOLOGY%20AND%20PLANT%20PATHOLOGY.pdf](https://admin/uploads/3/PG_M.Sc._Botony_34631%20MICROBIOLOGY%20AND%20PLANT%20PATHOLOGY.pdf)

Online Resources–

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

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

| | | |
|--|--|---|
| Continuous Internal Assessment (CIA): 15 (By Course Teacher) | Internal Test / Quiz-(2): 10 & 10 | 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 *[Signature]*
 ② *[Signature]*
 ③ *[Signature]*
 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

| PART- A: Introduction | | | |
|--|---|---|---|
| Program: Bachelor in Life Science <i>(Honors)</i> | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE -08 T | |
| 2 | Course Title | Growth and Stress Physiology | |
| 3 | Course Type | Discipline specific Elective (DSE) | |
| 4 | Pre-requisite (if, any) | As per program | |
| 5 | Course Learning Outcomes (CLO) | At the end of this course, the students will be able to 1. understand the role of Physiological and metabolic processes for plant growth and development under stress. 2. Assimilate about biochemical constitution of plant diversity. 3. Get acquired the students with complex interaction between organism and environment 4. Understand about the role of hormones in plant development. | |
| 6 | Credit Value | 3 Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | Plant Growth and Phytohormone ➤ Plant growth curve, sigmoid and J shaped growth. Lag, Log and steady stage. Developmental roles of phytohormones ➤ Auxins, ➤ Gibberellins, ➤ Cytokinins, ➤ ABA, ➤ Ethylene, | | 12 |
| II | Movements, Dormancy & Responses ➤ Photoperiodism (SDP, LDP, Day neutral plants); ➤ Phytochrome (discovery, structure and functions), ➤ Seed and bud Dormancy causes and breaking, ➤ Vernalization ➤ Senescence, ➤ Plant movements | | 11 |
| III | Planteco-physiology and Stress Physiology: ➤ Concept of Planteco-physiology. ➤ Plant perception, ➤ physiology of ecological considerations. ❖ Hydrophytic, xerophytic morphological and anatomical adaptations in plants | | 11 |
| IV | Stress Physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic tolerance, HR (Hypersensitive Response) and SAR Systemic Acquired Resistance), water deficit and ❖ Drought resistance, ❖ Salinity stress, ❖ metal toxicity, ❖ freezing and heat stress, ❖ oxidative stress. | | 11 |
| Keywords | Growth, Phytohormone, Eco-physiology, Vernalization. | | |
| Signature of Convener & Members (CBOS) : | | | |

① R. Sivas
 ② S. Sundar
 ③ M. S.

④ S. S.
 ⑤ S. S.
 ⑥ S. S.

⑦ S. S.
 ⑧ S. S.
 ⑨ S. S.
 ⑩ S. S.

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended-

1. Galston, 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 Wiley and Sons, Inc. New York, USA.
3. Salisbury, F.B. and Ross, C.W., (1992) Plant Physiology. Wadsworth Publishing Co., California, USA.
4. Denis, D.T., Turpin, D.H. Lefebvre, D.D. & Layzell, D.B. (1997) Plant Metabolism. Longman, Essex, England.

Reference Books Recommended -

- 1, Taiz, L. and Zeiger, E. (1998) Plant Physiology. Sinauer Associates, Inc. Pub., Massachusetts, USA.
2. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Online Resources-

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

<https://link.springer.com/book/10.1007/978-3-030-78420-1>

<https://uou.ac.in/sites/default/files/slm/MSCBOT-601.pdf>

<https://www.researchgate.net/publication/347908867> Stress Physiology in Plants

➤ https://www.esalq.usp.br/lepse/imgs/conteudo_thumb/Plant-stress-physiology.pdf

Online Resources-

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

➤ www.swayam.ac.in

➤ www.ignou.ac.in

➤ www.egvankosh.ac.in

➤ www.iitm.ac.in

➤ www.eskillindia.org

➤ www.eshiksha.mp.gov.in

➤ www.vlab.co.in

➤ www.internshala.com

➤ www.ndl.iitkgp.ac.in

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

| | | |
|---|--|--|
| Continuous Internal Assessment (CIA): 70 (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): 30 | 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 & Members of CBoS:

① Rajeev
② Renuka
③ h
④ h

⑤ h
⑥ h

⑦ h
⑧ h
⑨ h
⑩ h

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

| PART- A: Introduction | | | |
|---|---|---|--|
| Program: Bachelor in Life Science (Honors) | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | BOSE-08 P | |
| 2 | Course Title | Lab. Course -08 (Growth and stress physiology) | |
| 3 | Course Type | Laboratory course | |
| 4 | Pre-requisite (if, any) | As per program | |
| 5 | Course Learning Outcomes (CLO) | After the completion of the course the students will be able to: <ol style="list-style-type: none"> 1. Understand the role of Physiological and metabolic processes for plant growth and development under stress. 2. Assimilate about biochemical constitution of plant diversity 3. Effect of phytohormones on plants. 4. Understand different physiological processes of plants. | |
| 6 | Credit Value | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | Total Marks | Max. Marks: 50 | Min Passing Marks: 20 |
| PART -B: Content of the Course | | | |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | | No. of Period |
| Lab./Field Training/ Experiment Contents of Course | <ol style="list-style-type: none"> 1. <i>Avena</i> curvature test of Auxin. 2. Expression of bolting in cabbage. 3. Induction of lateral branches by cytokinin. 4. Demonstration of plasmolysis and deplasmolysis in plant cell. 5. Potato osmoscope for osmosis. 6. Demonstration of transpiration. 7. Measurement of transpiration rate by Farmers/ Ganong's potometer. 8. Extraction of seed proteins depending upon solubility. 9. Fractionation of proteins using gel filtration chromatography 10. Principle of colorimetry, spectrophotometry and fluorimetry. | | 30 |
| Keywords | Bolting, chlorophyll, osmosis, chromatography. | | |

Signature of Convener & Members (CBoS) :

① RD Pooja
 ② Anurag
 ③ [Signature]
 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. Practical Plant Physiology Hardcover – 1 January 2015 by R. Sivakumar, Narendra Publishing
2. PRACTICALS IN PLANT PHYSIOLOGY AND BIOCHEMISTRY MANJU BALA, SUNITA GUPTA, N.K GUPTA & M.K. SANGHA Scientific Publishers
3. A Practical Manual on Fundamentals of Plant Physiology Paperback – 16 September 2022 by R. K. Samaiya Subrata Sharma, Gyanendra Tiwari, R. Shivraj krishnan, Sunil Pandey, Preeti Sagar Nayak (Author) BFC PUBLICATIONS PVT LTD

Reference Books Recommended –

1. **Practical Manual Experimental Plant Physiology and Biochemistry Manual** Paperback – 1 January 2023 by Rajesh Kumar Asok Kumar Bera, Bandana Bose (Author) Publisher- Science Technology

Online Resources–

- e-Resources / e-books and e-learning portals
- <https://www.britannica.com/science/transpiration>
- <https://www.frontiersin.org/articles/10.3389/fagro.2022.765068/full>
- <https://www.sciencedirect.com/science/article/abs/pii/S0176161796802872>

Online Resources–

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

| | | |
|--|--|---|
| Continuous Internal Assessment (CIA): 35 (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): 15 | Laboratory / Field Skill Performance: On spot Assessment | |
| | A. Performed the Task based on lab. work - 20 Marks | Managed by Course teacher as per lab. status |
| | 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 R. Dinesh
② R. Dinesh
③ R. Dinesh
④ R. Dinesh
⑤ R. Dinesh
⑥ R. Dinesh

⑦ R. Dinesh
⑧ R. Dinesh
⑨ R. Dinesh
⑩ R. Dinesh

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
Course Curriculum

| PART- A: Introduction | | | |
|---|---|--|---|
| Program: Bachelor in Life Science <i>(Honors / Honors With Research)</i> | | Semester - VII | Session: 2024-25 |
| 1 | Course Code | ZOSC-07T | |
| 2 | Course Title | Biosystematics and Taxonomy | |
| 3 | Course Type | Discipline Specific Course | |
| 4 | Pre-requisite (if, any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes (CLO) | <p>After successfully completing this course the students will be able to -</p> <ul style="list-style-type: none"> ➤ Comprehend the basic concepts of Biosystematics and Tonomy. ➤ Understand and learn the Taxonomic Hierarchy in animal kingdom. ➤ Gain a basic knowledge and grasp the rules and philosophy of scientific nomenclature. ➤ Develop the critical understanding to identify the animals up to species level with the help of taxonomic keys. ➤ Learn the Newer trends in biosystematics and apply it in Research. | |
| 6 | Credit Value | 3 Credits | <i>Credit = 15 Hours - learning & Observation</i> |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | Introduction to systematic and classification: Definition & basic concepts of Biosystematics and Taxonomy. Historical resume of systematic. Taxonomic Hierarchy: Definition, Linnean hierarchy and categories. Classification: Purpose, use and basis. Theories of classification: Biological, artificial and natural classification. Levels of taxonomy: alpha, beta and gamma taxonomy. Micro and macro taxonomy. Scope and applications of biosystematics in biology. The relevance of systematics in conservation programs. | | 11 |
| II | Taxonomic Characters and Scientific Nomenclature: Different types of taxonomic characters (morphological, physiological, ecological, ethological and geographical characters). Zoological nomenclature: binominal and trinomial system, Principles and rules of International Code of Nomenclature (ICN), type material, author citation, criteria for publication, types of names, principle of priority and its limitations. | | 11 |
| III | Taxonomic Keys, Taxonomic treatment and Phylogenetics: Types of taxonomic key their merits and demerits. Type concept: Process of typification and different Zoological types and their applications. Taxonomic treatment of Allopatric variation, homology and Reproductive and geographical isolating mechanisms and their role in speciation process. Evolutionary taxonomy: Cladistics. Constructing trees/dendrograms: Phenogram, phylogram and cladogram and turning them into classifications. Mechanism of speciation in panmictic and apomictic species. Species concept: different species concepts, Species category: sub-species and other infra species categories. | | 12 |
| IV | Taxonomic procedure and Newer trends in biosystematics: Taxonomic Collection, curation, preservation, identification and classification. Newer trends in biosystematics: Morphological, Embryological, Behavioral, Ecological, Cytological and Biochemical approach. Numerical taxonomy. Differential systematic. Molecular taxonomy. DNA bar coding for identification of species. | | 11 |
| Keywords | <i>Systematic, classification, Linnean hierarchy, dendrograms, Nomenclature, Cladistics, Species category</i> | | |
| Signature of Convener & Members (CBoS) : | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- R.C. Dalella & R.S. Sharma, (2017) Animal Taxonomy & Museology. Jai Prakashnath & Co., Meerut.
- V.C. Kapoor (2019). Theory and practice of animal taxonomy and biodiversity, 8th Edn.

Reference Books Recommended –

- E. Mayer, (1991). Principles of Systematic Zoology.
- G.G. Simpson (2012). Principles of animal taxonomy. Scientific Publisher, India
- E.O. Wilson, (1988). Biodiversity. John Wiley & Sons.
- Futuyama, D. J. (1986). Evolution, Systematics and Animal Behaviour. Evolutionary Biology. Sinauer Associates Inc.
- Mayr, E. & Ashlock, P. D. (1991) Principles of Systematic Zoology (2nd edition) McGraw Hill Int.

Online Resources–

- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/qtrdnp2xfxe?e=0/species%20concept|||
- http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/214_21777_self_learning

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

| | | |
|---|--|---|
| Continuous Internal Assessment (CIA): (By Course Teacher) | Internal Test / Quiz-(2): 20 +20 | 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 & Members of CBoS:

Shahabuddin

sh

engim

swk

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

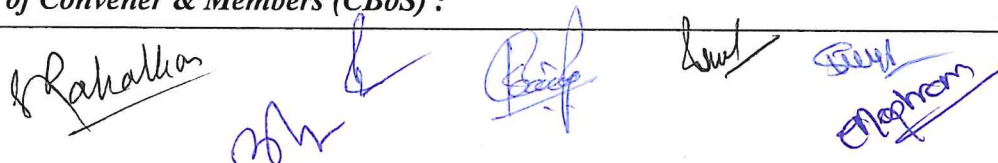
| PART- A: Introduction | | | |
|--|--------------------------------|--|---|
| Program: Bachelor in Life Science <i>(Honors / Honors with Research)</i> | | Semester -VII | Session: 2024-2025 |
| 1 | Course Code | ZOSC- 07P | |
| 2 | Course Title | Biosystematics and Taxonomy | |
| 3 | Course Type | Discipline Specific Lab Course | |
| 4 | Pre-requisite (if, any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes (CLO) | <p style="text-align: center;">After successfully completing this course the students will be able to</p> <ul style="list-style-type: none"> ➤ Comprehend the basic concepts of Biosystematics and Taxonomy. ➤ Understand and learn the Taxonomic Hierarchy in animal kingdom. ➤ Gain a basic grasp on the rules and philosophy of scientific nomenclature. ➤ Develop the critical understanding to identify the animals up to species level with the help of taxonomic keys. ➤ Learn the Newer trends in biosystematics and apply it in Research. | |
| 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 |

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 | <ul style="list-style-type: none"> • Study and sketch of museum specimens of Invertebrates and Vertebrates on the basis of systematic and Taxonomic Hierarchy • Preparation of identification keys for select specimens of non chordate (e.g., insects) and chordates (e.g., birds). • Make a record of biodiversity of college campus. • Construct the dendrograms, through Interactive software for exploring phylogeny and analyzing character • Use DNA bar coding for identification of species. • General discussion, distinguishing characters and classification of selected animals. • Generation of a character-state matrix by selecting and scoring diagnostic taxonomic characters. • Distance-based methods of phylogenetic reconstruction using manual and computer methods. • Group discussion/Viva or Seminar presentation on two related topics. • An “animal album or Practical Record” containing sketches, photographs, cut outs, with appropriate writes up about the above mentioned taxa. • Study of some videos to develop understanding on the animals of different taxa. | 30 |
| Keywords | <i>Museum specimens, dendrograms, bar coding, identification keys, phylogenetic</i> | |

Signature of Convener & Members (CBoS) :



PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- R.C. Dalella & R.S. Sharma, (2017) Animal Taxonomy & Museology. Jai Prakashnath & Co., Meerut.
- V.C. Kapoor (2019). Theory and practice of animal taxonomy and biodiversity, 8th Edn.
- S.S. Lal, Practical Zoology, Invertebrate. 12th Edition Rastogi Publications, Meerut, New Delhi.
- A manual of practical Zoology. Dr. P.S Verma, S. Chand Publication, New Delhi

Reference Books Recommended –

- E. Mayer, (1991). Principles of Systematic Zoology.
- G.G. Simpson (2012). Principles of animal taxonomy. Scientific Publisher, India

Online Resources–

- <http://ndl.iitkgp.ac.in/he document/swayamprabha/swayam prabha/qtrdnp2xfxe?e=0|speci es%20concept||>
- <http://ndl.iitkgp.ac.in/he document/swayam ugc moocs/214 21777 self learning>

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 | |
| | A. Performed the Task based on lab. work - 20 Marks | Managed by Course teacher as per lab. status |
| | 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:

(Handwritten signatures in blue ink)

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

| PART-A: Introduction | | | |
|--|--|--|---|
| Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i> | | Semester - VII | Session: 2024-25 |
| 1 | Course Code | ZOSE- 05T | |
| 2 | CourseTitle | Endocrinology | |
| 3 | CourseType | Discipline Specific Course | |
| 4 | Pre-requisite(if,any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes(CLO) | <p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Understand characters of hormones, their biochemical origin, functions and their role in physiology. ➤ Learn about the organization of endocrine glands and mechanism of hormone action. ➤ The learners will understand the hormonal disorders, and diseases. ➤ Comprehend about the role of hormone in healthy lifestyle. ➤ Develop insights on advancements in endocrinology. | |
| 6 | CreditValue | 3 Credits | Credit = 15 Hours - learning & Observation |
| 7 | TotalMarks | Max.Marks: 100 | Min Passing Marks:40 |
| PART -B: Content oftheCourse | | | |
| Total No. of Teaching-learning Periods(01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | <p>Chemical Regulators and Gene action: General characters, chemical structure & properties of Hormones. Comparison between hormone and enzymes. Types of chemical regulators: Hormone, Neurotransmitters, Parahormones, Semiochemicals: Pheromones, Lumones & Chalones. Hormone Receptors: Mechanism of hormone action and cell signaling, Second messengers: types and features. Gene & Hormone Action, Hormone Responsive Element. Feedback system in Hormone action, hormone delivery. The Lesser Known Regulatory Substances (Somatomedins, Prostaglandin, Eicosanoids, Thromboxane etc.) Analytical techniques of Hormone Assay: Radioimmuno assay, Enzyme linked immune sorbent assay, Immune histochemistry. Hormone Replacement Therapy.</p> | | 10 |
| II | <p>Neuro-endocrine system: Hypothalamus: Origin, Location, Gross Anatomy, and Structure. The Endocrine Hypothalamus: Hypothalamic Hormones, Hypothalamic Nuclei, General Functions of Hypothalamus, Hypothalamo-hypophysial portal system, Hypothalamo-hypophysial-gonadal axis. Pituitary Gland: Origin, Location, Structure, Hormones, Control of secretion & disorders. Regulation of pigmentation by Pars Intermedia in vertebrate chromatophores. Pineal Gland: Origin, Location, Structure, Hormones & Control of secretion, Overview of Biological Rhythm. Role of Oxytocin, Endorphin, Serotonin and Dopamine in temperament stability (Happiness Hormones & Mental Health). Neuro-endocrine system in Insects and its physiology.</p> | | 11 |
| III | <p>Endocrine System & Physiology I: Thyroid Gland: Organization of Mammalian Thyroid Gland, Biosynthesis of Thyroid Hormones, Metabolism of Thyroid Hormones, Regulation of Thyroid hormone secretion, Physiological & Metabolic Roles of Thyroxine, disorders of Thyroid Functions. Parathyroid Gland and Calcium Regulation. Calcium and Phosphate homeostasis. Adrenal Gland: Organization of Mammalian Adrenal Gland. The Adrenal Steroid Hormones (Synthesis Pathway & Physiological Roles), The Renin Angiotensin System, The Adrenal Medulla & Catecholamines (Synthesis Pathway and Mechanism of action of Catecholamines). Disorders of Adrenal Gland.</p> | | 12 |
| IV | <p>Endocrine System & Physiology II: The Endocrine Pancreas: Origin, Islet Cell Structure & cell types, Hormones of the endocrine pancreas, Insulin: Biochemistry, Synthesis, Mechanism of action and physiological role, Glucose Transporters in Mammals & Diabetes mellitus. Insulin Resistance. Hormones of Gonads: Gonadal steroid hormones, Biosynthesis, transport, metabolism and physiological effects. Role of hormones in ovarian cycle & Menopause. Hormones in Birth Control: Role of hormones in sex determination. Hormones of Gastrointestinal Tract: Action of Gastrointestinal Peptides in mammals. Hormonal control of feeding behaviour. Hormones and lifestyle disorders: Chronic stress, Blood Pressure & Obesity.</p> | | 12 |
| Keywords | <p><i>Hormone, Pheromones, Biosynthesis, Thyroid Gland, Adrenal Gland, Pancreas, Catecholamines, Sex Determination, Diabetes, Obesity.</i></p> | | |
| SignatureofConvener&Members (CBoS) : | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Chandra S. Negi: Introduction to Endocrinology, 2009, PHI
- Shastri V.K., Endocrinology and Reproductive Biology, Rastogi Publicatio

Reference Books Recommended –

- Hadley: Endocrinology (6th ed. 2009, Prentice Hall)
- Lodish et al :Molecular Cell Biology, W.H.Freeman& Co Ltd.
- Turner &Bagnara: General Endocrinology, 6th ed.1984, Saunders)
- Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press

Online Resources–

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>

Online Resources–

- <http://ndl.iitkgp.ac.in/he document/cec/ gFN1zyU718 PLNspmbLKJ8KYPKieHeF3oC4jZYt8zBe4>
- <https://egyankosh.ac.in/bitstream/123456789/33320/1/Unit-4.pdf>
- <https://www.ncbi.nlm.nih.gov/books/NBK441576/>

PART -D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment(CIA): 30 Marks

EndSemester Exam(ESE): 70 Marks

| | | |
|---|--|--|
| Continuous Internal Assessment (CIA): (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): | Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20Marks Section B: Descriptive answer type qts.,1out of 2 from each unit-4x10=40 Marks | |

Name and Signature of Convener & Members of CBoS:

(Handwritten signatures in blue ink)

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

| PART-A: Introduction | | | |
|---|--|--|--|
| Program: Bachelor in Life Science (Honors / Honors with Research) | | Semester - VII | Session: 2024-25 |
| 1 | CourseCode | ZOSE-05P | |
| 2 | CourseTitle | Endocrinology | |
| 3 | CourseType | Discipline Specific Elective Lab Course | |
| 4 | Pre-requisite(if,any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes(CLO) | <ul style="list-style-type: none"> ➤ Develop understanding of histological study of endocrine glands ➤ Learn the role anatomical aspects of various endocrine glands. ➤ Attain the fundamentals of applied endocrinology. ➤ Explore the operation of basic medical kits of routine usage. ➤ Create awareness towards lifestyle disorders related to hormones. | |
| 6 | CreditValue | 1 Credits | Credit =30 Hours Laboratory or Field learning/Training |
| 7 | TotalMarks | Max.Marks:50 | Min Passing Marks:20 |
| PART -B: Content oftheCourse | | | |
| TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours) | | | |
| Module | Topics (Course contents) | | No.ofPe riod |
| Lab./Field Training/ Experiment Contents of Course | <ul style="list-style-type: none"> • Study of histological slides of the endocrine glands. • Demonstration of Endocrine Glands of Cockroach. (Alternative Methods) • Demonstration of Endocrine Glands in Rat (Alternative Methods) • Study of Glucose Tolerance Test. • Principle of HbA1c Test. • General procedures and demonstration of glucometer operation. • Study of working principle / demonstration of Urine Pregnancy Tests (UPT). (Principle, Procedure, Interpretation and Limitations) • General Study of Normal Blood Parameters of different hormones (From Pathological Reports) • Group discussion/ Seminar/ Quiz/ Projects on Endocrinology • Preparation of Practical Record. | | 30 |
| Keywords | Endocrine Glands, Glucose Tolerance Test, HbA1c, Glucometer, Pregnancy | | |
| Signature of Convener & Members (CBoS): | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Lal S.S. Practical Zoology Vertebrates; Rastogi Publications
- Islam Mofidul, Das Viblab Kumar : Endocrinology with Practicals; Mahaveer Publications
- Verma P.S : A Manual of Practical Zoology Chordates; S.Chand Publications
- Arumugam N : Practical Zoology; Saras Publications.

Reference Books Recommended –

- Hadley: Endocrinology (6th ed. 2009, Prentice Hall)
- Lodish et al :Molecular Cell Biology, W.H.Freeman& Co Ltd.

Online Resources–

- <https://egyankosh.ac.in/bitstream/123456789/33320/1/Unit-4.pdf>

Online Resources–

- <https://www.ncbi.nlm.nih.gov/books/NBK532915/>
- <https://laboratorytests.org/urine-pregnancy-test/>

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

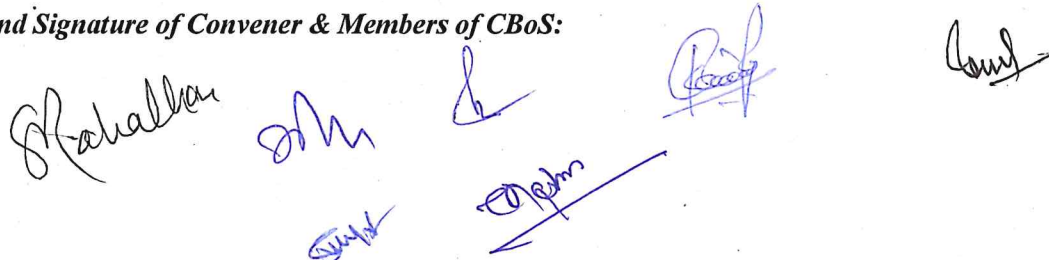
Maximum Marks: 50 Marks

Continuous Internal Assessment(CIA):15 Marks

End Semester Exam(ESE):35Marks

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

Name and Signature of Convener & Members of CBoS:



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

| PART-A: Introduction | | | |
|---|--|---|---|
| Program: Bachelor in Life Sciences (Honors / Honors with Research) | | Semester -VII | Session: 2024-2025 |
| 1 | Course Code | ZOSE – 06T | |
| 2 | Course Title | Immunology | |
| 3 | Course Type | Discipline Specific Elective | |
| 4 | Pre-requisite(if, any) | As per Program | |
| 5 | Course Learning Outcomes(CLO) | <p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Understanding of fundamental concepts of immunology. ➤ Gain knowledge on various immune cells, antigens and cytokines. ➤ Understand the structure and functions of Immunoglobulins and antibodies. ➤ Students will be able to describe the processes involved in immune system. ➤ Students will analyse the pathogenesis, clinical manifestations, and therapeutic approaches of various immune disorders and diseases and experimental techniques in Immunology. | |
| 6 | Credit Value | 3 Credits | Credit = 15 Hours -learning & Observation |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks:40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | Understanding of Immunological Concepts: Immune System: Brief history of Immunity, Concept & Types of Immunity (Innate and Acquired or Adaptive), Origin and Evolution of Immune System. Primary and Secondary lymphoid organs, lymphoid tissues. Thymic Selection: Self and non-self-recognition. Inflammation. Lymphocyte trafficking. Hematopoiesis. | | 10 |
| II | Components of Immune System- I: Cells of Immune System: Structure and functions of macrophages, granulocytes, NK cells, T and B lymphocytes and Antigen presenting cells. T & B Cell receptors, maturation, activation and differentiation of T& B Cell. Antigen: Antigenicity v/s immunogenicity, Factors affecting Immunogenicity, immunogen, haptens, super antigen, epitope, paratope. Adjuvants: Freund's complete and incomplete. Processing and presentation of Ag. Major histocompatibility complex (MHC) and HLA. Cytokines. | | 12 |
| III | Components of Immune System- II: Immunoglobulins: Nature, Primary structure of immunoglobulins. Enzymatic fragmentation of Ig. Domain structure of Ig and its significance. Types and subtypes of Ig and its characteristics. Membranous antibody. Antigenic determinants: isotype, allotype, idiotype. Abzymes. Theories of Antibody Formation: Instructive, selective, clonal selection theories and evidences; Immunological memory. Complement System. Hypersensitivity (Type I to IV with example) CMI & humoral immune response. Antigen-Antibody interaction: affinity & avidity. | | 13 |
| IV | Immune disorders & Immuno-techniques: Auto-immunity: Auto-recognition, classes of auto-immuno diseases. (Hashimoto disease, Thyrotoxicosis, Systemic lupus erythematosus, Rheumatoid arthritis).Transplantation: Autograft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions. Immune Deficiencies: Primary and secondary immune deficiencies. T-cell, B-cell and SCID, AIDS. Vaccination and types of vaccines (First, Second & Third generation vaccines). Immunological techniques: Precipitin curve, Immuno-diffusion, one and two dimensional, single radial immuno-diffusion, Double (Ouchterlony) immune-diffusion. Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique.Radio-immunoassay: ELISA–Principle, Methodology and applications. Immuno-fluorescence: Direct, indirect and Sandwich, in situ localization by techniques:FISH and GISH. Hybridoma, Monoclonal antibodies. | | 10 |
| Keywords | Immunity, lymphocytes, Antigens, Immunoglobulins, Auto-immunity, Vaccination &Immuno-techniques. | | |
| Signature of Convener & Members (CBoS): | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Pravash Sen. Gupta, Clinical Immunology. Oxford University Press. 2003.
- N Arumugam, Immunology, Saras Publication. 2014.
- Fatima D, Arumugam, Immunology, Saras Publication

Reference Books Recommended –

- Janis Kuby, Immunology, II edition. W. H. Freeman and Company, New York. 1993.
- Ivan M. Roitt, J. Brostoff and D. K. Male, Immunology, Gower Medical Publishing, London. 1993.

Online Resources–

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>
- http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/hdc5c5m6hkq?e=1|immunology|||
- <https://xvivo.com/examples/the-innate-immune-system/>
- <https://xvivo.com/examples/the-adaptive-immune-system/>

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

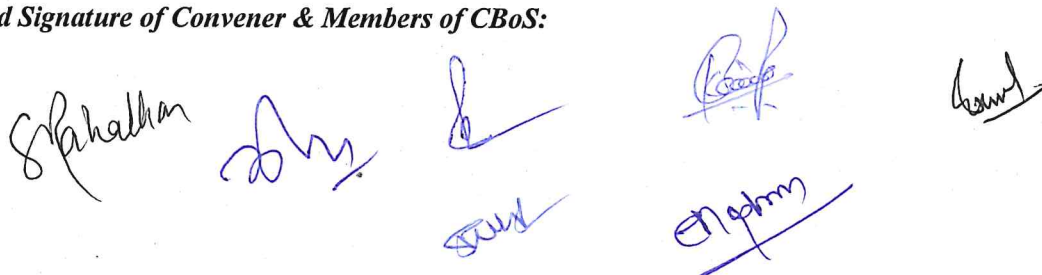
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener & Members of CBoS:



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

| PART- A: Introduction | | | |
|---|--|---|---|
| Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i> | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | ZOSE-06P | |
| 2 | Course Title | Immunology | |
| 3 | Course Type | Discipline Specific Elective Lab Course | |
| 4 | Pre-requisite (if, any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes (CLO) | <p style="text-align: center;">At the end of this course, the students will be able -</p> <ul style="list-style-type: none"> ➤ Gain practical knowledge on various immune cells, antigens and antibodies. ➤ Identify the major cellular and tissue components which comprise the innate and adaptive immune system. ➤ Students will experimental techniques in Immunology. ➤ Understand how does the immune system distinguish self from non-self. ➤ Gain experience at reading and evaluating the scientific literature in the area. | |
| 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 |
| 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 | <ul style="list-style-type: none"> • Study of permanent slides of organs of immune system • Enumeration of total leucocytes from human blood samples • Enumeration of differential leucocytes from human blood samples • Demonstration of agglutination reaction using human RBC • Demonstration of Ag-Ab precipitation by immunodiffusion technique • Antigen detection by radial immunodiffusion technique (RID) • Estimation of total serum protein • Estimation of serum gamma globulins/Separation of γ-globulin by salt precipitation. • Estimation of A/G ratio • Isolation of lymphocyte by using density gradient centrifugation • Paper and gel immuno-electrophoresis • Rocket immunoelectrophoresis • Counter current immunoelectrophoresis • ELISA • Group discussion/Quiz/ Seminar presentation on related topics. • Making of Practical record. | | 30 |
| Keywords | <i>Leucocytes, Rocket immunoelectrophoresis, ELISA, A/G ratio, RID</i> | | |
| Signature of Convener & Members (CBoS) : | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Talwar G.P. and Gupta S.K, A Handbook Of Practical And Clinical Immunology Volume 1, CBS Publication
- Zane, Immunology: Theoretical And Practical Concepts In Laboratory Medicine, ELSEVIER

Reference Books Recommended –

- Goldsby, R.A.; Kindt, T.J. and Kuby, J. (2006) Immunology (6th edition).
- Roitt, I.; Brostoff, J. and Male, D. (2012) Immunology (8th edition).

Online Resources–

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>
- [http://ndl.iitkgp.ac.in/he document/swayamprabha/swayam prabha/hdc5c5m6hkq?e=1immunology](http://ndl.iitkgp.ac.in/he%20document/swayamprabha/swayam%20prabha/hdc5c5m6hkq?e=1immunology)
- <https://xvivo.com/examples/the-innate-immune-system/>
- <https://xvivo.com/examples/the-adaptive-immune-system/>

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 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:

Alahalla

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

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

| PART-A: Introduction | | | |
|--|---|--|---|
| Program: Bachelor in Life Science (Honors/Honors with Research) | | Semester - VII | |
| | | Session: 2024-2025 | |
| 1 | CourseCode | ZOSE- 07T | |
| 2 | CourseTitle | Biotechnology & Genetic Engineering | |
| 3 | CourseType | Discipline Specific Elective | |
| 4 | Pre-requisite(if,any) | As per Program | |
| 5 | Course Learning Outcomes(CLO) | <p>After successfully completing this course, the students will be able to-</p> <ul style="list-style-type: none"> ➤ Define the concept of recombinant DNA and genetic engineering. ➤ Understand the molecular techniques and their proficiencies. ➤ Apply the knowledge of gene manipulation techniques. ➤ Analyze different prospects and applications of genetic engineering and bioinformatics. ➤ Develop understanding of ethical, social and legal implications of genetic engineering. | |
| 6 | CreditValue | 3 Credits | Credit = 15 Hours -learning & Observation |
| 7 | TotalMarks | Max.Marks: 100 | Min Passing Marks:40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course Contents) | | No. of Period |
| I | Introduction to Biotechnology: An overview of Biotechnology: History, Definition, scope, applications and ethical issues in biotechnology. Recombinant DNA, Restriction Enzymes, Application of different enzymes in Recombinant DNA technology, Restriction and modification system, Linkers & Adaptors, Restriction mapping. Vectors (Cloning and Expression Vectors). Gene Recombination and Gene transfer: Transfection, Transduction, Microinjection, Electroporation and Ultrasonication. Antibiotic Resistant Gene and their mode of action. Polymerase chain reaction (PCR): Principle and applications of different types of PCR. DNA and RNA Purification. | | 11 |
| II | Elementary Genetic Engineering: Preparation and comparison of Genomic and cDNA library, screening of recombinants, Genome: organization, coding and non-coding sequences & genome mapping, Comparative genome hybridization. Whole genome shotgun sequencing, Chromosome Banding. Gene tagging, DNA Cloning, DNA Sequencing methods, DNA profiling. Genetic Markers, Molecular markers: Types & Features. Stem Cells: Embryonic Stem Cells, Adult Stem Cells and Induced Pluripotent Stem Cells, Formation and selection of recombinant ES cells, Role of ES cells in gene targeting in mice, Gene Probe, Colony Hybridization, Blotting Techniques (Southern, Northern, Western and Eastern Blotting), Animal Cell Culture (Primary Cultures, Cell line, Transformation characteristics, Culture Media & Growth Cycle). | | 11 |
| III | Advancements in Genetic Engineering: Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis. Gene Editing, Gene shuffling, Genetic Manipulation of Animal Cells (Transgenesis and transgenic animals), Gene Knockout, Nuclear Transfer Technology and Animal Cloning, Gene Therapy, Gene Delivery System (Virus mediated transduction & non-viral transduction methods). Molecular Farming (Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines), Microarrays and next generation sequencing technologies. | | 12 |
| IV | Applications of Genetic Engineering & Bioinformatics: Cord blood banking, Genetically Modified Organism (GMO), Animals as bioreactors: Genetically engineered animals for research. Conditional knock outs using cre-loxP recombination; tissue specific promoters, CRISPR-Cas9 and its applications in treating genetic disorders. Genetic modification of livestock for improved productivity and disease resistance. Ethical, Legal, and Social Implications (ELSI) of genetic engineering. Bioinformatics: Overview and its relation with molecular biology. Biological Databases: Overview, Applications & Prospects. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB) and software (RASMOL, Ligand Explorer), Data generation; Generation of large scale molecular biology data. (Through Genome sequencing) File Format (Genbank, DDBJ, FASTA, PDB, Swiss Prot). Sequence Alignments and Visualization, General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum). | | 11 |
| Keywords | Recombinant DNA, Genome, Gene, Mutagenesis, Microarray, Techniques, Biological Database. | | |
| Signature of Convener & Members (CBoS): | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Lehninger – Principles of Biochemistry, WH Freeman.
- Satyanarayan U - Biotechnology, Saras Publication
- Gupta P.K. – Elements of Biotechnology, Rastogi Publications.
- Gupta P.K. – Biotechnology and Genomics, Rastogi Publications.
- Kumar Pranav, Verma Praveen, Meena Usha – Biotechnology: A problem approach- Pathfinder Publications.
- Rastogi S.C., Rastogi P., Mendiratta N : Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, PHI Learning.
- Bosu Orpita, Thukral S.K.- Bioinformatics: Experiments, Tools, Databases, and Algorithms – Oxford University Press

Reference Books Recommended –

- Lodish H et al., - Freeman
- Watson JD et al.-Macmillan - Recombinant DNA: Genes and Genomes, A Short Course.
- Alberts B et al., Molecular Biology of the Cell, - Garland
- Brown TA – Genomes, Garland

Online Resources–

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=31BI+Y/JyQo+vltwaZoj+g==>
- <http://ndl.iitkgp.ac.in/he document/swayamprabha/swayam prabha/ksrdg67pyn8?e=1|bioinformatics|||>
- <http://ndl.iitkgp.ac.in/he document/nptel/nptel/courses 102 106 102106065 video lec66?e=3|bioinformatics|||>
- [http://ndl.iitkgp.ac.in/he document/cec/cec/0F oDrArwTU PLNspmbLKJ8K5HAWhRVvEHRBSI1XVO-oE?e=0|biotechnology%20:%20genome%20editing%20tools%20-%203%20\(crispr/cas9\)|||](http://ndl.iitkgp.ac.in/he document/cec/cec/0F oDrArwTU PLNspmbLKJ8K5HAWhRVvEHRBSI1XVO-oE?e=0|biotechnology%20:%20genome%20editing%20tools%20-%203%20(crispr/cas9)|||)

Online Resources–

- <https://vlab.amrita.edu/?sub=3&brch=274&sim=1428&cnt=1>
- <http://ndl.iitkgp.ac.in/he document/cec/PRwJGpzUSYM PLNspmbLKJ8K5HAWhRVvEHRBSI1XVO-oE>

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener & Members of CBoS:















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

| PART-A: Introduction | | | |
|---|--|--|---|
| Program: Bachelor in Life Science (Honors/Honors with Research) | | Semester - VII | Session: 2024-2025 |
| 1 | CourseCode | ZOSE- 07P | |
| 2 | CourseTitle | Biotechnology & Genetic Engineering | |
| 3 | CourseType | Discipline Specific Elective Lab Course | |
| 4 | Pre-requisite(if,any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes(CLO) | <p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Learn to prepare aseptic techniques in laboratory for biotechnology experiments. ➤ Understand the fundamental experiments & techniques of biotechnology & genetic engineering. ➤ Develop practical skills in genetic engineering techniques and laboratory procedures. ➤ Learn characteristics of genetic material. ➤ Analyze applications of diverse genetic engineering protocols. | |
| 6 | CreditValue | 1 Credits | <i>Credit =30 Hours Laboratory or Field learning/Training</i> |
| 7 | TotalMarks | Max.Marks:50 | Min Passing Marks:20 |
| PART -B: Content of the Course | | | |
| TotalNo.of learning-Training/performancePeriods:30 Periods (30 Hours) | | | |
| Module | Topics(Course contents) | | No. of Period |
| Lab./Field Training/ Experiment Contents of Course | <ul style="list-style-type: none"> • Sterilisation of glassware, media and laboratory. • Working principle and applications of- Hot Air Oven, Autoclave & Laminar flow hood. • Demonstration of cell culture techniques. • Demonstration of gene library and cDNA library. • Isolation of DNA from plant sample. • Isolation of plasmid DNA from E. coli cells. • Isolation of genomic DNA from whole blood. • Demonstration of Gel electrophoresis techniques. • Separation and visualization of DNA fragments using agarose gel electrophoresis. • Spectrophotometric estimation of isolated DNA. • Restriction digestion of plasmid DNA and genomic DNA. • Study related to working principle of PCR machine. • Preparation of Minimal Essential Growth medium. • Staining the cultured cells using dyes such as hematoxylin and eosin (H&E), and observe them under a light microscope to study cell morphology and structure. • Bioinformatics: Analyse DNA or protein sequences using online tools and databases. • Demonstration of online data bases for bioinformatics-based studies. • Demonstration of DNA band visualization techniques (e.g., Ethidium bromide staining, DNA intercalating dyes) • Group discussion/ Quiz/Project/Seminar presentation on related topics. • Practical Record <p style="text-align: center;"><i>Note: Virtual mode of demonstration can be opted if required.</i></p> | | 30 |
| Keywords | Sterilization, Autoclave, Electrophoresis, Restriction, PCR, Plasmid, Genomic, Bioinformatics | | |
| Signature of Convener & Members (CBoS): | | | |

PART-C: Learning Resources

Text Books Recommended -

- Aneja K.R.; Laboratory manual of microbiology and biotechnology; Medtech.
- Ramdass P; Practical Biotechnology; JaypeeBrothers Medical Publishers; First Edition.

Reference Books Recommended -

- Wilson, K., & Walker, J. Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press.
- Kurian K. Noble; A complete lab manual for Biotechnology; Notion Press.
- Borah Debajit; Biotechnology Lab Practices; Global Vision Publishing House.
- Portner Ralph; Animal Cell Biotechnology: Methods and Protocols: Humana Press Springer Protocols

Online Resources-

- <https://indiabioscience.org/media/articles/DBT-Life-Science-Protocol-Manual.pdf>
- https://webstor.srmist.edu.in/web_assets/downloads/2021/20BTC502J-lab-manual.pdf

Online Resources-

- <https://learn.genetics.utah.edu/content/labs/>

PART-D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

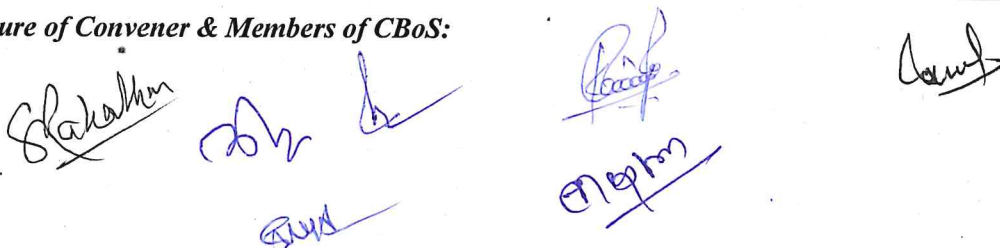
Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

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

Name and Signature of Convener & Members of CBoS:



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

| PART- A: Introduction | | | |
|---|---|---|--|
| Program: Bachelor in Life Science (Honors/ Honors with Research Degree) | | Semester -VII | Session: 2024-2025 |
| 1 | Course Code | ZOSE- 08T | |
| 2 | Course Title | Applied Zoology | |
| 3 | Course Type | Discipline Specific Elective | |
| 4 | Pre-requisite (if, any) | As per Program | |
| 5 | Course Learning Outcomes (CLO) | <p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Understand the culture techniques of prawn, pearl and fish, Lac culture. ➤ Understand silkworms rearing and their products. ➤ Understand the Bee keeping equipments and apiary management. ➤ Understand dairy animal's management. ➤ Learn the testing of egg and milk quality. ➤ Apply this knowledge for Setting up a self-employment venture in the field. | |
| 6 | Credit Value | 3 Credits | Credit = 15 Hours - learning & Observation |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |
| PART -B: Content of the Course | | | |
| Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours) | | | |
| Unit | Topics (Course contents) | | No. of Period |
| I | <p>Aquaculture: Prawn culture: Culture of fresh water prawn and marine prawn. Preparation of farm for Prawn culture. Preservation and processing of prawn. Export of prawn. Pearl Culture: pearl formation, protocol followed, Fresh Water Fish Culture: Qualities or Characters of Cultivable Fishes, Construction of Fish Farm. Fish Breeding: bundh and induced. Fish Seed: Types, Seed collection: Benchi jal (Shooting net), hatching Hapa. Transport of Seed: Open and closed system, Causes of mortality in transport. Use of chemicals in live fish transport: Anesthetic drugs. Antiseptics and Antibiotics. Harvesting of fish: By hooks and nets (Triangular net, Dip net and Cast net). Fish preservation. Fish diseases and their control.</p> | | 12 |
| II | <p>Apiculture and Sericulture: Apiculture: Species of honey bees. Morphology and life cycle of <i>Apis indica</i>. Social behaviour of honey bees: Colony organization, division of labour and communication. Methods of Bee keeping: Indigenous and Modern method, appliances used for bee keeping, management of honey bees and their hives, Extraction of honey from the comb and processing, bee Products and their economic importance. Natural enemies & diseases of Bee and their management. Sericulture: Types of silk, Silkworms and their host plants, Life history of <i>Bombyx mori</i> Rearing of <i>Bombyx mori</i>: Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages. Harvesting of cocoons, Silkworm diseases and their control: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis. Silkworm pests and parasites and their management: Uzi fly, Dermestid beetles. Silk reeling techniques. Quality assessment of silk fibre.</p> | | 11 |
| III | <p>Lac Culture and Vermiculture: Lac Culture History of lac. Cultivation of lac: Host plants, Lac insect and its life cycle. Control of lac insect pests processing and collection of lac. Lac composition, products and uses. Vermiculture: Biology of <i>Eisenia foetida</i>. Rearing of earthworms. Equipments, devices used in vermiculture. Vermicompost Technology: Methods and products, Vermiwash Collection, Composition and use.</p> | | 11 |
| IV | <p>Dairy management and Poultry farming: Dairy: Introduction to common dairy animals. Techniques of dairy management: System of housing. Milk and milk products. Cattle Diseases and control measures. Poultry: Types of breeds. Methods of brooding and Rearing. Housing and Equipment, Deep litter System, Laying cages, Debeaking, Incubation and hatching of eggs. Management of growers, Layers, Broilers. Feed formulations for chicks, Diseases and control measures. Nutritive value of egg and meet.</p> | | 11 |
| Keywords | Aquaculture, Apiculture, Sericulture, Poultry farming, Dairy Farming, Vermiculture | | |
| Signature of Convener & Members (CBoS) : | | | |

PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Srivastava, C. B. L. (1999). *Fishery Science and Indian Fisheries*. Kitab Mahal publications, India.
- Sardar Singh, *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.
- Dhyan Singh Bisht, *Apiculture*, ICAR Publication.
- Shukla G.S., Upadhyay V.B. *Economic Zoology*, Rastogi Publication
- Ahasan J, Sinha,S.P.(2010) *Handbook of Economic Zoology*, S Chand Publication
- Jabde, P. *Text book of Applied Zoology* (2008), Discovery Publishing Pvt. Ltd

Reference Books Recommended –

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Sericulture, *FAO Manual of Sericulture*.
- Hafez, E. S. E. (1962). *Reproduction in Farm Animals*, Lea and Fabiger Publishers.
- Knobil, E. and Neill, J. D. (2006). *The Physiology of Reproduction*, Vol. 2, Elsevier Publishers.

Online Resources–

- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1608.pdf
- <https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20sericultureapiculture%20lac%20culture%20and%20sericulture%20upload.pdf>
- https://kvk.icar.gov.in/API/Content/PPupload/k0160_11.pdf
- <https://dahd.nic.in/sites/default/files/Excerpts%20of%20Poultry%20Farmn%20Manual.pdf>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

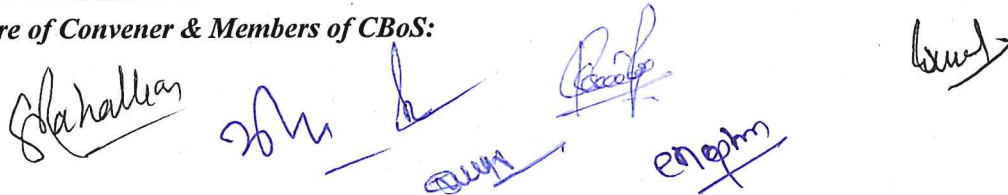
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

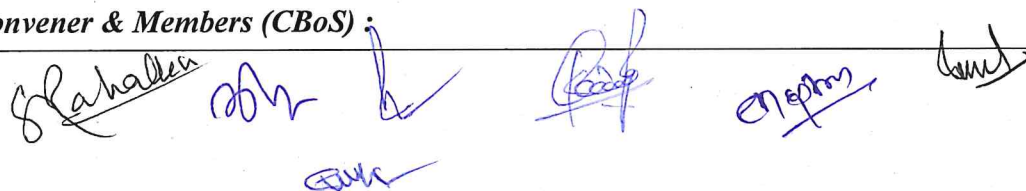
| | | |
|---|--|--|
| Continuous Internal Assessment (CIA): (By Course Teacher) | Internal Test / Quiz-(2): 20 +20 | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks |
| | Assignment / Seminar - 10 | |
| | Total Marks - 30 | |
| End Semester 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 & Members of CBoS:



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

| PART- A: Introduction | | | |
|---|---|---|---|
| Program: Bachelor in Life Science <i>(Honors/ Honors with Research)</i> | | Semester - VII | Session: 2024-2025 |
| 1 | Course Code | ZOSE-08P | |
| 2 | Course Title | Applied Zoology | |
| 3 | Course Type | Discipline Specific Elective Lab Course | |
| 4 | Pre-requisite (if, any) | <i>As per Program</i> | |
| 5 | Course Learning Outcomes (CLO) | <p>After successfully completing this course, the students will be able to:</p> <ul style="list-style-type: none"> ➤ Know common species of carps, prawn, oyster. ➤ Understand and learn the culture techniques of prawn, pearl, fish, honey bee, silkworm, lac, vermicompost. ➤ Understand and Learn division of labor and identification of Honey bees ➤ Identify Lac insect, male female morphology,. ➤ Understand dairy management, breeds of Cow & diseases and learn to analyze to good quality of milk, egg and vermicompost. | |
| 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 |
| 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 | <ul style="list-style-type: none"> ➤ Morphological characterization of common edible fish species. ➤ Identification of major carps. ➤ Morphology of Freshwater and Marine Prawn ➤ Pearl oyster, pearl forming species ➤ Identification of castes of Honey bee and life cycle (through charts/specimens). ➤ Mounting of the sting apparatus. ➤ Worker honey bee with emphasis on leg modifications (through specimens/charts) and whole mount preparation of the 3 pairs of legs, Mouth parts. ➤ Life cycle of mulberry silkworm, <i>Bombyx mori</i> (model/chart/specimens) and life cycle of tasar silkworm, <i>Antheraea mylitta</i>. ➤ Identification of dairy animals ((model/chart/Photographs). ➤ Milk testing: Qualitative test of milk, Determination of the specific gravity of milk by using a mercury lactometer. ➤ External morphology of poultry birds (model). ➤ Test for good quality eggs (Floating test, cracking test) and for fertilized and unfertilized eggs (Light test, Cracking test). ➤ Project report on visit to Fish farm/dairy farm/ Poultry farm/.etc ➤ Group discussion/quiz/seminar on related topics. ➤ Preparation of practical record or Album. | 30 | |
| Keywords | <i>Aquaculture, Apiculture, Sericulture, Poultry farming, Dairy Farming</i> | | |
| Signature of Convener & Members (CBoS) : | | | |



PART-C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Upadhyay, Economic Zoology
- Salvamani B R, & Mahadevan R K, Aquaculture Trends and Issues
- Jabde V, Applied Zoology Pradeep
- Shukla Prasad Economic Zoology, Biostatistics and Animal Behaviour

Online Resources–

- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBT1608.pdf
- <https://egov.uok.edu.in/elearning/tutorials/1011020512BR15103CR15Apiculture%20Lac%20culture%20and%20%20sericultureapiculture%20lac%20culture%20and%20%20sericulture%20upload.pdf>

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

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

Name and Signature of Convener & Members of CBoS:

