UNDERGRADUATE DEGREE COURSE

# Bachelor of Science (CBZ)

# University of Technology

## Vatika Road, Jaipur Rajasthan 303903

| UNDERGRADUATE DEGREE COURSE<br>Department of B.Sc.(CBZ) 2023 | |
|---|---|
| **Program Outcomes** | |
| PO 1 | Students will be able to demonstrate a fundamental understanding of concepts of subject including Physics, Chemistry & Mathematics |
| PO 2 | Students will be proficient in mathematical and computational skills, enabling them to model physical systems, solve complex problems, and analyze experimental data effectively. |
| PO 3 | Students will be adept in experimental and laboratory skills, mastering experimental design, data collection, instrumentation, and analysis techniques relevant to physics. |
| PO 4 | Students will be able to apply the concept in interdisciplinary contexts, integrating their knowledge into fields such as engineering, materials science, biophysics, and environmental science. |
| PO 5 | Students will be capable of cultivating critical thinking and problem-solving abilities, analyzing theoretical models, interpreting experimental results, and addressing complex problems. |
| PO 6 | Students will acquire advanced knowledge in specialized areas of science |
| PO 7 | Students will be proficient in utilizing quantitative and qualitative analysis skills, investigating physical phenomena, interpreting data, and deriving meaningful conclusions. |
| PO 8 | Students will effectively communicate scientific ideas, presenting concepts, experimental findings, and theoretical models through written reports, oral presentations, and visual representations. |
| PO 9 | Students will uphold ethical and professional conduct in science, demonstrating integrity, responsibility, and collaboration in scientific research and laboratory practices. |
| PO 10 | Students will integrate theoretical concepts with practical applications, applying their knowledge to technological innovations, industrial advancements, and theoretical developments. |
| PO 11 | Students will prepare for advanced studies and research in subject, equipping themselves for careers in academia, research institutions, industry, and governmental agencies. |
| PO 12 | Students will contribute to scientific knowledge and innovation, advancing the field through research, innovation, and the application of science principles to address global challenges. |
| | |
| Program Specific Outcomes | |
| PSO 1 | Demonstrate mastery in applying fundamental principles of subjects Physics, Chemistry & Math |

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|---|---|
| PSO 2 | Develop the ability to analyze and predict the behavior of systems, including Physics, Chemistry & Math |
| PSO 3 | Develop the ability to design and conduct experiments to test hypotheses and gather data to support physical principles. |
| PSO 4 | Develop the ability to use computational tools, such as simulations and programming languages, to model and analyze physical systems. |
| PSO 5 | Attainan in-depth knowledge of the principles of modern physics, including relativity, quantum mechanics, and particle physics. |
| | |
| Program Educational Objectives | |
| PEO 1 | To develop a thorough understanding of fundamental concepts of the subjects |
| PEO 2 | To acquire proficiency in experimental techniques, including data collection, analysis using advanced laboratory equipment, and quantitative methods. |
| PEO 3 | To master computational modeling and simulation skills, enabling prediction and analysis of physical phenomena in diverse scientific and technological applications. |
| PEO 4 | To foster critical thinking and problem-solving abilities, facilitating the analysis of theoretical models, interpretation of experimental data, and application of physics principles to real-world challenges. |
| PEO 5 | To enhance communication skills, enabling effective presentation of scientific ideas and collaboration in interdisciplinary teams for advancing knowledge and innovation in physics. |

UNDERGRADUATE DEGREE COURSE

# Bachelor of Science (CBZ) - 1st Year

## JULY-2023

# University of Technology

# Vatika Road, Jaipur Rajasthan 303903

# UNIVERSITY OF TECHNOLOGY, JAIPUR

## Teaching & Examination Scheme

### Bachelor of Science (CBZ) - 1st Year

**B.Sc. (CBZ) - 1st Year**

| Sr. No. | Subject Name | Subject Code | Subject Type | Credit Point | Tot. Max Marks | Int. Min Marks | Int. Max Marks | Ext. Min Marks | Ext. Max Marks | Teach Hours | Count Marks | Print Enable | Status | Update on New ERP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | General Hindi | BCBZ 101 | Theoretical | 2 | 100 | 0 | 0 | 36 | 100 | 2 | No | Yes | Yes | Yes |
| 2 | General English | BCBZ 102 | Theoretical | 2 | 100 | 0 | 0 | 36 | 100 | 2 | No | Yes | Yes | Yes |
| 3 | Environmental Studies | BCBZ 103 | Theoretical | 2 | 100 | 0 | 0 | 36 | 100 | 2 | No | Yes | Yes | Yes |
| 4 | Elementary Computer | BCBZ 104 | Theoretical | 1 | 60 | 0 | 0 | 22 | 60 | 1 | No | Yes | Yes | Yes |
| 5 | Chemistry - I | BCBZ 105 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 6 | Chemistry - II | BCBZ 106 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 7 | Chemistry - III | BCBZ 107 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 8 | Botany - I | BCBZ 108 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 9 | Botany - II | BCBZ 109 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 10 | Botany - III | BCBZ 110 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 11 | Zoology - I | BCBZ 111 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 12 | Zoology - II | BCBZ 112 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 13 | Zoology - III | BCBZ 113 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 | Yes | Yes | Yes | Yes |
| 14 | Computer Lab | BCBZ 151 | Practical | 1 | 40 | 0 | 0 | 14 | 40 | 2 | No | Yes | Yes | Yes |
| 15 | Chemistry Lab | BCBZ 152 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 | Yes | Yes | Yes | Yes |
| 16 | Botany Lab | BCBZ 153 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 | Yes | Yes | Yes | Yes |
| 17 | Zoology Lab | BCBZ 154 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 | Yes | Yes | Yes | Yes |
| | | | | **33+8** | **675** | **0** | **0** | **243** | **675** | **39+9** | | | | |

***L:*** *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

***ETE:*** *End Term Exam,* ***IA:*** *Internal Assessment*

**Course Name- B.Sc.(CBZ) 1st Year**

**Course Code- [BCBZ 101]**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc.(CBZ) 1st Year**

**Paper Name- General Hindi**

**Students will be able to:**

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|---|---|
| **CO 1** | Describe Hindi morphology and syntax |
| **CO 2** | Explain grammatical rules and exceptions. |
| **CO 3** | Read and comprehend Hindi prose and poetry. |
| **CO 4** | Analyze literary devices and themes. |
| **CO 5** | Analyze literary devices and themes. |

## Course Outline (CO)

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|---|---|
| **1** | Unit-1/ Hindi Language and Grammar /4 Hours Per Week |
| **2** | Unit-2/ Hindi Literature / 4 Hours Per Week |
| **3** | Unit-3/ Reading and Writing / 5 Hours Per Week |
| **4** | Unit-4/ Speaking and Listening / 5 Hours Per Week |
| **5** | Unit-5/ Applied Hindi /4 Hours Per Week |

**Detailed Syllabus**

| | |
|---|---|
| **Module-1** | Hindi Language and Grammar: Hindi alphabet and pronunciation, Hindi grammar rules (sandhi, vachya, etc.), Hindi vocabulary (shabdaavali) |
| **Module-2** | Hindi Literature: Hindi poetry (kavya), Hindi prose (gadya), Hindi authors and their works (Bhakti movement, etc.) |
| **Module-3** | Reading and Writing: Hindi reading comprehension, Hindi composition writing (nibandh, etc.), Hindi letter writing (patra lekhan) |
| **Module-4** | Speaking and Listening: Hindi conversation skills, Hindi presentation skills, Hindi listening comprehension |
| **Module-5** | Applied Hindi: Hindi in everyday life, Hindi in science and technology, Hindi in literature and culture |

**Recommended Books**


1. "Hindi Vyakaran aur Rachna" by Dr. S. C. Gupta (Publication: Lakshya Publication)
2. "Hindi Sahitya ka Itihas" by Dr. Ramchandra Shukla (Publication: Hindi Sahitya Sadan)
3. "Hindi Nibandh" by Dr. O. P. Singh (Publication: Kitab Mahal)
4. Hindi Vyakaran" by Dr. S. K. Mishra (Publication: Bharati Bhawan)
5. "Hindi Rachna" by Dr. L. N. Sharma (Publication: Lakshya Publication)
6. "Hindi Sahitya ka Swaroop" by Dr. R. C. Sharma (Publication: Hindi Sahitya Sadan)

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| **Course Name- B.Sc.(CBZ) 1st Year** | |
| **Course Code- [BCBZ 102]** | |
| **Credits-6 (L: 3 T: 1 P: 0)** | |
| **Course Outcomes (COs)** | |
| **B.Sc.(CBZ) 1st Year** | |
| **Paper Name- General English** | |
| **Students will be able to:** | |
| **CO 1** | Understand the basics of English grammar, vocabulary, and syntax. |
| **CO 2** | Recognize various literary and non-literary texts, including fiction, non-fiction, poetry, and drama. |
| **CO 3** | Identify and analyze different writing styles, tone, and purposes. |
| **CO 4** | Familiarize themselves with linguistic and cultural nuances. |
| **CO 5** | Use language effectively in academic, scientific, and professional situations**.** |
| **Course Outline (CO)** | |
| **1** | Unit-1/ Comprehension and Vocabulary /4 Hours Per Week |
| **2** | Unit-2/ Composition / 4 Hours Per Week |
| **3** | Unit-3/ Grammar and Usage/ 5 Hours Per Week |
| **4** | Unit-4/ Reading Comprehension / 5 Hours Per Week |
| **5** | Unit-5/ Communication Skills /4 Hours Per Week |
| **Detailed Syllabus** | |
| **Module-1** | Comprehension and Vocabulary:<br>a. Questions based on content from the prescribed text<br>b. Questions based on a passage from the prescribed text to test the candidate's comprehension and vocabulary<br>c. Questions based on an unseen passage to test the candidate's Comprehension and vocabulary (There will be a text of essays and short stories between 100 and in length.) |
| **Module-2** | Composition a. Letter/Application writing 10 Marks b. Paragraph writing/Précis writing 10 Marks c. Report Writing |
| **Module-3** | Grammar and Usage<br>The Questions in this exercise will be set with the purpose of testing the candidate's knowledge of grammar and familiarity with correct usage.<br>A. Elements of sentence<br>B. Transformation of Sentences<br>C. Active and Passive Voice<br>D. Modals<br>E. Determiners<br>F. Common Errors in English |
| **Module-4** | Reading Comprehension: Fiction (short stories, novels), Non-fiction (essays, articles) Poetry, Writing Skills: Essay writing, Report writing, Creative writing |

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|---|---|---|
| | **Module-5** | Communication Skills: Verbal communication, Non-verbal communication, Group discussions<br>Literary Analysis: Literary devices (metaphor, simile, etc.) Themes and characters,<br>Critical thinking and analysis |
| **Recommended Books** | | |
| | | 1. General English" by various authors (Lakshya Publication)<br>2. "English Language and Literature" by S. K. Singh (Kitab Mahal)<br>3. "English Grammar and Composition" by Wren and Martin (S. Chand Publishing) |
| | | |

**Course Name- B.Sc.(CBZ) 1st Year**

**Course Code- [BCBZ 103]**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc.(CBZ) 1st Year**

**Paper Name- Environmental Studies**

**Students will be able to:**

| | |
|---|---|
| **CO 1** | Remembering: Recall environmental concepts, laws, and policies. |
| **CO 2** | Understanding: Interpret environmental issues and their impact. |
| **CO 3** | Applying: Use environmental knowledge to solve problems. |
| **CO 4** | Analyzing: Evaluate environmental information and develop solutions. |
| **CO 5** | Creating: Develop innovative solutions to environmental challenges. |

## Course Outline (CO)

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|---|---|
| **1** | Unit-1/ Reference systems /4 Hours Per Week |
| **2** | Unit-2/ Origin of the quantum theory / 4 Hours Per Week |
| **3** | Unit-3/ Quantum Mechanics / 5 Hours Per Week |
| **4** | Unit-4/ Structure of nuclei / 5 Hours Per Week |
| **5** | Unit-5/ Reference systems /4 Hours Per Week |

**Detailed Syllabus**

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|---|---|
| **Module-1** | Introduction to Environmental Studies : Environment and ecology, Ecosystems and biodiversity, Environmental importance, Environmental challenges |
| **Module-2** | Human Impact on the Environment : Pollution (air, water, soil), Climate change and global warming, Deforestation and land degradation, Human population and environment, Environmental health |
| **Module-3** | Human Impact on the Environment: Pollution (air, water, soil), Climate change and global warming, Deforestation and land degradation, Human population and environment, Environmental health |
| **Module-4** | Environmental Policies and Issues : Environmental laws and regulations, International environmental agreements (Kyoto Protocol, etc.), National Environmental Policy (NEP), Environmental movements and organizations |

| | | |
|---|---|---|
| | **Module-5** | VALUE OF BIODIVERSITY: CONSUMPTIVE, PRODUCTIVE USE, SOCIAL, ETHICAL,<br>AESTHETIC AND OPTION VALUES : Consumptive value, Productive value, Social value, Ethical value, Aesthetic value, Option value |
| **Recommended Books** | | |
| | | 1. Environmental Studies" by Erach Bharucha (University of Pune)<br>2. "Environmental Studies: A Practical Approach" by R. C. Trivedy and M. P. Singh (Tata McGraw-Hill)<br>3. "Environmental Science" by M. K. Jha (Vikas Publishing House)<br>4. "Environmental Studies: Principles and Practice" by D. D. Kapur and R. C. Trivedy (New Age International)<br>5. "Environmental Science and Technology" by J. L. Rao (S. Chand Publishing)<br>6. "Environmental Ecology" by P. D. Sharma (Rastogi Publications) |
| | | |

## Course Name- B.Sc.(CBZ) 1st Year

## Course Code- BCBZ 104

## Credits-6 (L: 3 T: 1 P: 0)

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|---|---|---|
| | **Course Outcomes (COs)** | |
| | **B.Sc.(CBZ) 1st Year** | |
| | **Paper Name- Elementary Computer** | |
| | **Students will be able to:** | |
| | **CO 1** | Define environmental studies and its scope. |
| | **CO 2** | Identify the components of the natural environment (air, water, soil, biodiversity). |
| | **CO 3** | Explain human impact on the environment (pollution, climate change, deforestation). |
| | **CO 4** | Describe environmental laws, policies, and regulations. |
| | **CO 5** | Define environmental studies and its scope. |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Computer Fundamentals / 4 Hours Per Week |
| | **3** | Unit-3/ Programming Basics / 5 Hours Per Week |
| | **4** | Unit-4/ Computer Applications / 5 Hours Per Week |
| | **5** | Unit-5/ Manage an email account /4 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction: objective, scope and outcome of the course. |
| | **Module-2** | Computer Fundamentals: Computer hardware and software, Data representation and storage, Input/output devices, Computer networking, Computer security, Emerging trends |

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| | **Module-3** | Programming Basics: Introduction to programming, Data types and variables, Control structures (if-else, loops), Functions and modules, Arrays and strings, File handling, Basic programming using C/Python |
| | **Module-4** | Computer Applications : MS Office (Word, Excel, PowerPoint), Internet and email basics, Web browsing and search engines, Online safety and security, Basic graphic design, Spreadsheet analysis, Presentation skills, Collaborative document editing |
| | **Module-5** | Manage an email account: E mail address, Configure E-mail Account, Log to an Email, Receive & send email, Sending files & attachment & address book, Downloading files, Online form filling, E-services, E-banking & E- Learning |

**Recommended Books**


1. "Computer Fundamentals" by P. K. Sinha (BPB Publications)
2. "Introduction to Computers" by Peter Norton (McGraw-Hill Education)
3. "Computer Science" by Timothy J. Barth (Cengage Learning)
4. "Computer Organization and Architecture" by William Stallings (Pearson Education)
5. "Data Structures and Algorithms" by Alfred V. Aho (Addison-Wesley)
6. "Computer Networks" by Andrew S. Tanenbaum (Prentice Hall)


**Course Name- B.Sc. (CBZ) - 1st Year**

**Course Code- [BCBZ 108]**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc. (CBZ) - 1st Year**

**Paper Name- Chemistry – I**

**Students will be able to:**

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|---|---|
| **CO 1** | Describe atomic structure and periodic trends. |
| **CO 2** | Explain chemical bonding theories (ionic, covalent, metallic). |
| **CO 3** | Identify and classify main group elements. |
| **CO 4** | Understand acid-base chemistry. |
| **CO 5** | Analyze and interpret chemical data |

## Course Outline (CO)

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|---|---|
| **1** | Unit-1/ Introduction /4 Hours Per Week |
| **2** | Unit-2/ Ionic solids / 4 Hours Per Week |
| **3** | Unit-3/ Covalent Bond / 5 Hours Per Week |
| **4** | Unit-4/ S-Block Elements / 5 Hours Per Week |
| **5** | Unit-5/ Important Compounds of P block Elements /4 Hours Per Week |

**Detailed Syllabus**

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|---|---|
| **Module-1** | Introduction to objective, scope and outcome of the course |

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| | **Module-2** | Ionic solids: Ionic structures, radius ratio, effects & coordination number, limitation of radius ratio rule, lattice defects, semiconductors, Lattice energy & born Haber cycle Solvation energy & solubility of ionic solids, polarizing power & polarisability of ions<br>Metallic bond: Free electron, Valence bond & bond theories<br>Weak Interaction: Hydrogen bonding, vander wall forces |
| | **Module-3** | Covalent Bond: Valence bond theory & its limitations, directional & shapes of simple inorganic molecules & ions, valence shell electro pair repulsion (VSPER) theory to $NH_3$. $H_3O^+$, $SF_4$ , $CIF_3$, $ICL_2$, $H_2O$<br>Molecular Orbital theory: homonuclear & hetronuclear (CO & NO) diamond molecules, Multicenter bonding in electron deficient molecules, bond strength & bond energy, percentage ionic character of dipole moment & electronegativity difference |
| | **Module-4** | S-Block Elements: Comparative study, diagonal relationships, silent features of hydrides, solvation & complexion tendencies including their function in biosystem, an introduction to alkyls & aryls<br>Periodicity of P block elements, reference to atomic & ionic radii, ionization energy, electron affinity, electron energy diagonal relationship, catenation |
| | **Module-5** | Important Compounds of P block Elements: Hydrides of boron, diborane & higher Borane, Borazine, Borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principal), tetrasulphar, tetranitride, basic properties of halogen, Interhalogens & polyhalides<br>Chemistry of noble gases: Chemical properties of noble gases, chemistry of xenon, structure & bonding of xenon compounds |

**Recommended Books**

| | | |
|---|---|---|
| | | 1. "Physical Chemistry" by Peter W. Atkins (Oxford University Press)<br>2. "Physical Chemistry" by Thomas Engel and Philip Reid (Pearson Education)<br>3. "Physical Chemistry: A Molecular Approach" by D. A. McQuarrie and J. D. Simon (University Science Books)<br>4. "Physical Chemistry: An Introduction" by J. M. Seddon and J. D. Gale (Oxford University Press)<br>5. "Physical Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International) |
| | | |

**Course Name- B.Sc. (CBZ) - 1st Year**

**Course Code- [BCBZ 109]**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc. (CBZ) - 1st Year**

**Paper Name- Chemistry – II**

**Students will be able to:**

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|---|---|
| **CO 1** | Describe classification and nomenclature of organic compounds. |
| **CO 2** | Explain structural and stereochemical principles. |
| **CO 3** | Identify and analyze functional groups. |
| **CO 4** | Understand basic organic reactions. |
| **CO 5** | Analyze and interpret organic spectra |

| | | |
|---|---|---|
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction to objective /4 Hours Per Week |
| | **2** | Unit-2/ Mechanism of Organic Reactions / 4 Hours Per Week |
| | **3** | Unit-3/ Stereochemistry of Organic compounds / 5 Hours Per Week |
| | **4** | Unit-4/ Alkanes & Cycloalkanes / 5 Hours Per Week |
| | **5** | Unit-5/ Isolated conjugated & cumulated dienes /4 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | **Introduction to objective, scope and outcome of the course.** |
| | **Module-2** | Mechanism of Organic Reactions: Homolytic & Hetrolytic bonds , Clevage type of regents, electrophiles & nucleophiles, Reactive intermediates- carbocations, free radicals, carbenes, arynes & nitrenes (with examples), Types of organic reactions,<br>Energy considerations, Methods of determination of reaction mechanism, intermediates, isotrope effects, kinetic & stereo chemical studies) |
| | **Module-3** | Stereochemistry of Organic compounds : Concepts of isomerism, Types of isomerism, Difference between configuration & confirmation, Flying wedge & Fisher wedge Projection formulae<br>Optical Isomerism: Elements of symmetry, molecular chirality, enantiomers, stereogenicenters, Optical activities, Properties of enantiomers, chiral & achiral molecules with two streriogenic centers, Disastereomers, Resolution of enantiomers, Inversion, retention & racemization, Z system of nomenclature, Geometric Isomerism in oximes & alicyclic compounds<br>Conformal Isomerism: Newman Projection & Sawhorse Formulae, Conformal analysis of ethane, n-butane Cyclohexane |
| | **Module-4** | Alkanes & Cycloalkanes: IUPAC Nomenclature of branched & unbranched alkyl group, classification of carbon atoms in alkanes, Methods of formations, Kolbe reaction, Corey House reaction & decarboxylation, Physical properties & chemical reactions of alkanes, Mechanism of free radicals, Reactivity & selectivity, Cycloalkanes- nomenclature methods of formation, chemical reactions, Baeyer's strain Theory & its limitations, Theory of stainless rings<br>Alkenes, Cycloalkenes, Dienes & Alkynes: Methods of Formation, mechanism of dehydration of alcohols & dehydrohelogenation of alkyl hailides, Regioselectivity of<br>Alcohol dehydration- the saytzeff rule, Hoffmen elimination, Physical properties & relative stabilities, Chemical reaction of alkenes- mechanism involved in hydrogenation, electrophilic & free radical additions, Markownikoff 's rule, hydroboration & oxidation with $KMnO_4$, Polymerization of alkenes, Substitution of alicyclic & vinylic position of alkenes |
| | **Module-5** | Classification & nomenclature of isolated conjugated & cumulated dienes, Method of formation properties, Structure & bonding of alkynes, Methods of formation, Chemical reactions- acidity of alkynes, mechanism of electrophilic & nucleophilic addition reactions, hydroboration oxidation, metal ammonia reduction, Oxidation & polymerization |
| **Recommended Books** | | |

| | | |
|---|---|---|
| | | 1. "Inorganic Chemistry" by James E. Huheey (HarperCollins Publishers)<br>2. "Inorganic Chemistry" by Gary L. Miessler and Donald A. Tarr (Pearson Education)<br>3. Inorganic Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International)<br>4. "Inorganic Chemistry: A Unified Approach" by R. L. DeKock and T. P. Gray (McGraw-Hill Education)<br>5. Organic Chemistry" by Jerry March et al. (Wiley-Interscience)<br>6. "Organic Chemistry" by Francis A. Carey and Richard J. Sundberg (McGraw-Hill Education)<br>7. Physical Chemistry" by Thomas Engel and Philip Reid (Pearson Education) |
| | | |

**Course Name-** B.Sc. (CBZ) - 1st Year

**Course Code- BCBZ 105**

**Credits-6 (L: 3 T: 1 P: 0)**

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|---|---|---|
| | **Course Outcomes (COs)** | |
| | **B.Sc. (CBZ) - 1st Year** | |
| | **Paper Name- Chemistry – III** | |
| | **Students will be able to:** | |
| | **CO 1** | Describe classification and nomenclature of organic compounds. |
| | **CO 2** | Explain structural and stereochemical principles. |
| | **CO 3** | Identify and analyze functional groups. |
| | **CO 4** | Understand basic organic reactions. |
| | **CO 5** | Apply mathematical models to physical chemistry problems. |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Mathematical Concepts / 4 Hours Per Week |
| | **3** | Unit-3/ Gaseous States / 5 Hours Per Week |
| | **4** | Unit-4/ Solid States / 5 Hours Per Week |
| | **5** | Unit-5/ Colloidal States /4 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | **Introduction to objective, scope and outcome of the course.** |
| | **Module-2** | Mathematical Concepts: Logarithmic relations, Curve sketching, Linear graphs & calculation of slopes, Differentiation of function like $k_x$, $e^x$, $x^n$ , sinx & log x, maxima & minima, Integration of some useful functions, Permutation & combination's, Factorials & Probability<br><br>Liquid state: Intermolecular forces, Structure of liquids, Structural differentiation between solid, liquid & gases, Liquid crystals: Difference between liquid crystal, solid & liquid, Thermography & 7 segment cells. |

| | | |
|---|---|---|
| | **Module-3** | Gaseous States: Definition and properties of gases, Gas laws (Boyle's, Charles', Avogadro's), Ideal Gas Equation, Real gases and deviations from ideality, Applications of gas laws<br><br>Kinetic Theory of Gases: Molecular structure and intermolecular forces, Maxwell-Boltzmann distribution, Kinetic energy and temperature, Collisions and mean free path, Transport phenomena (diffusion, viscosity), Thermal conductivity and heat transfer, Kinetic theory of gas mixtures |
| | **Module-4** | Solid States: Introduction to Solids, classification of solids, Crystal structures and unit cells, Lattice parameters and crystal systems<br>Crystal Structures: Bravais lattices and crystal systems, Miller indices and lattice planes, Crystal symmetry and point groups, Space groups and crystal structures, Defects in crystal structures<br><br>Bonding in Solids : Ionic bonding and electrostatic forces, Covalent bonding and molecular orbitals, Metallic bonding and free electron model, Hydrogen bonding and van der Waals forces, Bonding in semiconductors |
| | **Module-5** | Colloidal States: Introduction, Definition and importance of colloids, Types of colloids (lyophobic, lyophilic), Preparation methods (condensation, dispersion)<br><br>Properties of Colloids: Brownian motion and sedimentation, Electrokinetic phenomena (electrophoresis, electroosmosis), Interfacial tension and surface energy, Viscosity and rheology of colloids |

**Recommended Books**

| | | |
|---|---|---|
| | | 1. Physical Chemistry: A Molecular Approach" by D. A. McQuarrie and J. D. Simon (University Science Books)<br>2. "Physical Chemistry" by Peter W. Atkins (Oxford University Press)<br>3. "Physical Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International)<br>4. "Advanced Inorganic Chemistry" by Cotton and Wilkinson (Wiley-Interscience)<br>5. "Inorganic Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International)<br>6. "Inorganic Chemistry" by Gary L. Miessler and Donald A. Tarr (Pearson Education) |
| | | |

**Course Name- B.Sc. (CBZ) -1st Year**

**Course Code- BCBZ 108**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc. (CBZ) - 1st Year**

**Paper Name- Botany - I**

**Students will be able to:**

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|---|---|
| **CO 1** | Explain plant cell structure and function. |
| **CO 2** | Describe photosynthesis and respiration. |
| **CO 3** | Understand plant morphology and anatomy. |

| | | |
|---|---|---|
| | **CO 4** | Analyze plant diversity and classification. |
| | **CO 5** | Prepare and analyze plant tissue sections. |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Plant Cell Biology / 4 Hours Per Week |
| | **3** | Unit-3/ Photosynthesis and Respiration / 5 Hours Per Week |
| | **4** | Unit-4/ Plant Morphology and Anatomy / 5 Hours Per Week |
| | **5** | Unit-5/ Plant Diversity and Classification /4 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course |
| | **Module-2** | Plant Cell Biology: Plant cell structure and function, Cell wall and membrane, Cyttoplasm and organelles, Nucleus and chromosomes |
| | **Module-3** | Photosynthesis and Respiration : Photosynthesis: light and dark reactions , Respiration: aerobic and anaerobic, Electron transport chain, ATP synthesis |
| | **Module-4** | Plant Morphology and Anatomy: Plant body and its organization, Root and stem anatomy Leaf anatomy and morphology, Flower and fruit structure |
| | **Module-5** | Plant Diversity and Classification : Kingdoms of life, Plant classification: artificial and natural Angiosperm classification, Plant identification using taxonomic keys |
| **Recommended Books** | | |
| | | 1. Botany for Degree Students by A.C. Dutta<br>2. Plant Biology by Lincoln Taiz and Eduardo Zeiger<br>3. Botany by R.N. Singh |
| | | |

**Course Name- B.Sc. (CBZ) -1st Year**

**Course Code- BCBZ 109**

**Credits-6 (L: 3 T: 1 P: 0)**

| | | |
|---|---|---|
| | **Course Outcomes (COs)** | |
| | **B.Sc. (CBZ) - 1st Year** | |
| | **Paper Name- Botany - II** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain Mendelian genetics and chromosomal theory. |
| | **CO 2** | Describe plant adaptations to environmental factors. |
| | **CO 3** | Understand plant physiology and hormone regulation. |
| | **CO 4** | Analyze diversity of Bryophytes, Pteridophytes, and Gymnosperms. |
| | **CO 5** | Measure transpiration and photosynthesis rates. |

| | | |
|---|---|---|
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Genetics and Evolution / 4 Hours Per Week |
| | **3** | Unit-3/ Plant Ecology / 5 Hours Per Week |
| | **4** | Unit-4/ Plant Physiology / 5 Hours Per Week |
| | **5** | Unit-5/ Bryophytes, Pteridophytes, and Gymnosperms /4 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course |
| | **Module-2** | Genetics and Evolution : Mendelian genetics, Chromosomal theory of inheritance<br>Gene expression and regulation, Evolution: mechanisms and evidence |
| | **Module-3** | Plant Ecology : Ecosystems and community dynamics, Plant adaptations to environment<br>Ecological succession, Conservation biology |
| | **Module-4** | Plant Physiology : Water relations and transport, Mineral nutrition and uptake, Hormone regulation, Plant growth and development |
| | **Module-5** | Bryophytes, Pteridophytes, and Gymnosperms: Bryophyte diversity and life cycle<br>Pteridophyte diversity and life cycle, Gymnosperm diversity and life cycle, Comparative study of plant groups |
| **Recommended Books** | | |
| | | 1. Botany for Degree Students by A.C. Dutta<br>2. Plant Biology by Lincoln Taiz and Eduardo Zeiger<br>3. Botany by R.N. Singh |
| | | |

**Course Name- B.Sc. (CBZ) -1st Year**

**Course Code- BCBZ 110**

**Credits-6 (L: 3 T: 1 P: 0)**

| | | |
|---|---|---|
| | **Course Outcomes (COs)** | |
| | **B.Sc. (CBZ) - 1st Year** | |
| | **Paper Name- Botany - III** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain principles of plant taxonomy. |
| | **CO 2** | Describe characteristics of major plant families. |
| | **CO 3** | Understand phylogeny and evolution of plants. |
| | **CO 4** | Analyze plant diversity and distribution. |
| | **CO 5** | Prepare and analyze plant specimens |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |

| | | |
|---|---|---|
| | **2** | Unit-2/ Plant Taxonomy / 4 Hours Per Week |
| | **3** | Unit-3/ Plant Diversity / 5 Hours Per Week |
| | **4** | Unit-4/ Phylogeny and Evolution / 5 Hours Per Week |
| | **5** | Unit-5/ Plant Families /4 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course |
| | **Module-2** | Plant Taxonomy : Principles of plant taxonomy, Taxonomic hierarchy,Plant classification systems |
| | **Module-3** | Plant Diversity : Angiosperm diversity, Gymnosperm diversity, Plant distribution and ecology |
| | **Module-4** | Phylogeny and Evolution : Phylogenetic analysis, Plant evolution, Molecular systematics |
| | **Module-5** | Plant Families : Fabaceae, Solanaceae, Poaceae |
| **Recommended Books** | | |
| | **1.** | Plant Taxonomy by G. H. Maheshwari |
| | **2.** | Botany for Degree Students by A. C. Dutta |
| | **3.** | Plant Biology by Lincoln Taiz and Eduardo Zeiger |
| | | |

**Course Name- B.Sc. (CBZ) -1st Year**

**Course Code- BCBZ 111**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc. (CBZ) - 1st Year**

**Paper Name- Zoology- I**

**Students will be able to:**

| | |
|---|---|
| **CO 1** | Explain animal diversity and classification. |
| **CO 2** | Describe cell structure and function. |
| **CO 3** | Understand tissue and organ organization. |
| **CO 4** | Analyze evolutionary relationships among animals. |
| **CO 5** | Identify and classify animal specimens. |

## Course Outline (CO)

| | |
|---|---|
| **1** | Unit-1/ Introduction /4 Hours Per Week |
| **2** | Unit-2/ Animal Diversity / 4 Hours Per Week |
| **3** | Unit-3/ Cell Biology / 5 Hours Per Week |
| **4** | Unit-4/ Tissue and Organ Organization / 5 Hours Per Week |
| **5** | Unit-5/ Animal Morphology /4 Hours Per Week |

**Detailed Syllabus**

| | | |
|---|---|---|
| | **Module-1** | Introduction to objective, scope and outcome of the course |
| | **Module-2** | Animal Diversity : Classification and phylogeny, Animal kingdoms (Monera to Animalia) Evolutionary relationships |
| | **Module-3** | Cell Biology : Cell structure and function, Cellular transport and signalling, Cell division and genetics |
| | **Module-4** | Tissue and Organ Organization: Epithelial and connective tissues, Muscle and nervous tissues, Organ systems (nervous, circulatory) |
| | **Module-5** | Animal Morphology: Protozoa to Porifera, Cnidaria to Mollusca, Echinodermata to Chordata |

**Recommended Books**

| | |
|---|---|
| **1.** | Zoology by R. L. Kotpal |
| **2.** | Animal Biology by P. S. Verma |
| **3.** | Cell Biology by E. B. Lozanov |

**Course Name- B.Sc. (CBZ) -1st Year**

**Course Code- BCBZ 111**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc. (CBZ) - 1st Year**

**Paper Name- Zoology- II**

**Students will be able to:**

| | |
|---|---|
| **CO 1** | Explain animal physiology and homeostasis. |
| **CO 2** | Describe genetic principles and inheritance. |
| **CO 3** | Understand animal development and growth. |
| **CO 4** | Analyze ecological relationships among animals. |
| **CO 5** | Apply ecological principles to solve problem |

## Course Outline (CO)

| | |
|---|---|
| **1** | Unit-1/ Introduction /4 Hours Per Week |
| **2** | Unit-2/ Animal Physiology / 4 Hours Per Week |
| **3** | Unit-3/ Genetics / 5 Hours Per Week |
| **4** | Unit-4/ Animal Development / 5 Hours Per Week |
| **5** | Unit-5/ Ecology /4 Hours Per Week |

**Detailed Syllabus**

| | |
|---|---|
| **Module-1** | Introduction to objective, scope and outcome of the course |
| **Module-2** | Animal Physiology : Homeostasis and regulation, Nervous and endocrine systems, Circulatory and respiratory systems |
| **Module-3** | Genetics : Mendelian genetics, Chromosomal genetics, Molecular genetics |
| **Module-4** | Animal Development : Embryology, Developmental biology, Growth and regeneration |

| | | |
|---|---|---|
| | **Module-5** | Ecology : Ecosystems and community dynamics, Population ecology, Conservation biology |

**Recommended Books**

| | | |
|---|---|---|
| | 1. | Animal Physiology by R. L. Kotpal |
| | 2. | Genetics by P. S. Verma |
| | 3. | Ecology by E. B. Lozanov |
| | | |

**Course Name- B.Sc. (CBZ) -1st Year**

**Course Code- BCBZ 113**

**Credits-6 (L: 3 T: 1 P: 0)**

## Course Outcomes (COs)

**B.Sc. (CBZ) - 1st Year**

**Paper Name- Zoology- III**

**Students will be able to:**

| | | |
|---|---|---|
| | **CO 1** | Explain animal behavior and social structure. |
| | **CO 2** | Describe evolutionary mechanisms and processes. |
| | **CO 3** | Understand biotechnological applications in zoology. |
| | **CO 4** | Analyze conservation biology and wildlife management. |
| | **CO 5** | Evaluate and analyze animal data. |

## Course Outline (CO)

| | | |
|---|---|---|
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Animal Behavior / 4 Hours Per Week |
| | **3** | Unit-3/ Evolution / 5 Hours Per Week |
| | **4** | Unit-4/ Biotechnology / 5 Hours Per Week |
| | **5** | Unit-5/ Conservation Biology /4 Hours Per Week |

**Detailed Syllabus**

| | | |
|---|---|---|
| | **Module-1** | Introduction to objective, scope and outcome of the course |
| | **Module-2** | Animal Behavior: Behavioral ecology, Social behavior and communication, Learning and memory |
| | **Module-3** | Evolution : Evolutionary mechanisms, Phylogeny and systematics, Molecular evolution |
| | **Module-4** | Biotechnology : Genetic engineering, Biomedical applications, Conservation biotechnology |
| | **Module-5** | Conservation Biology: Biodiversity and extinction, Wildlife management and conservation Ecological restoration |

**Recommended Books**

| | | |
|---|---|---|
| | 1. | Animal Behavior by J. R. Krebs |
| | 2. | Evolution by D. J. Futuyma |
| | 3. | Biotechnology by G. S. Manning |

# UNIVERSITY OF TECHNOLOGY, JAIPUR

**Syllabus**

**1st Year B.Sc. (CBZ) - July-2022**

**Computer Lab [BCBZ 151]**

**Credit 1** **Max. Marks: 100(IA: 60, ETE:40)**
**0L+0T+2P**

| | List of Experiments |
|---|---|
| 1 | Computer Fundamentals: Introduction to computers, Hardware and software components, Operating systems (Windows, Linux), Basic computer architecture |
| 2 | Programming in Python : Introduction to Python, Variables, data types, and operators Control structures (loops, conditional statements), Functions and modules, Lists, tuples, and dictionaries, File handling and input/output operations |
| 3 | Object-Oriented Programming (OOP) concepts using Python, Error handling and debugging, Python libraries (NumPy, Pandas), Data visualization using Matplotlib, Case studies and projects |
| 4 | Numerical Computing : Numerical methods for algebraic equations, Numerical differentiation and integration, Numerical solutions of ordinary differential equations |
| 5 | Interpolation and extrapolation: Data analysis and visualization, Numerical methods for partial differential equations, Case studies and projects |
| | |

**Chemistry Lab [BCBZ152]**

**Credit 1** **Max. Marks: 100(IA: 60, ETE:40)**
**0L+0T+2P**

| | List of Experiments |
|---|---|
| 1 | Separation & identifications of 6 radical's in the give inorganic mixture including spatial combinations |
| 2 | Determine the melting point (naphthalene, benzoic acid, urea etc.) boiling point (methanol, ethanol, cyclohexane etc.) mixed melting point (urea, cinnamic acid etc.) |
| 3 | Determine the specific reaction rate of the hydrolysis of methyl acetate/ ethyl acetate catalyzed by hydrogen ions at room temperature |
| 4 | To study the effect of acid strength on the hydrolysis of an ester |
| 5 | To compare the strength of HCL & $H_2SO_4$ by studying the kinetics of hydrolysis of ethyl acetate |
| 6 | To study kinetically the reaction rate of decomposition of iodide by $H_2O_2$ |
| 7 | To determine the viscosity/ surface tension of pure liquid (alcohol etc.) at room temperature. |
| 8 | To determine the percentage composition of a given binary mixture by surface tension method |
| 9 | To determine the percentage composition of a given binary mixture by viscosity method |

# UNIVERSITY OF TECHNOLOGY, JAIPUR

**Syllabus**

**2nd Year B.Sc. (CBZ) - July-2022**

## Botony Lab [BCBZ153]

**Credit 1** **Max. Marks: 100(IA: 60, ETE:40)**

**0L+0T+2P**

| List of Experiments | |
|---|---|
| 1 | Plant Morphology: Study of root, stem, leaf, flower, and fruit, Measurement of plant parts, Drawing and labeling of plant structures. |
| 2 | Cell Biology: Study of plant cells and tissues, Preparation of temporary mounts. Observation of cell division. |
| 3 | Photosynthesis: Measurement of photosynthetic rate., Study of chlorophyll content, Effect of light intensity on photosynthesis. |
| 4 | Plant Identification: Study of plant families., Identification of plants using taxonomic keys, Preparation of herbarium specimens. |
| 5 | Plant Physiology: Study of transpiration, Measurement of water potential, Effect of temperature on plant growth. |
| 6 | Microscopy: Study of microscope parts, Preparation of permanent mounts, Observation of plant tissues. |

## Zoology Lab [BCBZ154]

**Credit 1** **Max. Marks: 100(IA: 60, ETE:40)**

**0L+0T+2P**

| List of Experiments | |
|---|---|
| 1 | Study of Protozoa: Study of Amoeba, Paramecium, and Euglena., Preparation of temporary mounts, Observation of locomotion and feeding. |
| 2 | Study of Coelenterates: Study of Hydra and jellyfish, Observation of cnidoblasts. Study of regeneration. |
| 3 | Study of Annelids: Study of earthworm anatomy, Dissection and study of reproductive system, Observation of setae. |
| 4 | Study of Fish Anatomy: Dissection and study of external features, Study of skeletal and muscular systems, Observation of gills and scales. |
| 5 | Study of Fish Anatomy: Dissection and study of external features, Study of skeletal and muscular systems, Observation of gills and scales. |
| 6 | Study of Mammalian Anatomy: Study of rabbit anatomy, Dissection and study of internal organs. Observation of circulatory and nervous systems. |

UNDERGRADUATE DEGREE COURSE

# B.Sc. (CBZ) 2nd Year

# University of Technology

## Vatika Road, Jaipur Rajasthan 303903

## B.Sc (CBZ) - 2nd Year

| Sr. No. | Subject Name | Subject Code | Subject Type | Credit Point | Tot. Max Marks | Int. Min Marks | Int. Max Marks | Ext. Min Marks | Ext. Max Marks | Teach Hours |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Chemistry - I | BCBZ 205 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 2 | Chemistry - II | BCBZ 206 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 3 | Chemistry - III | BCBZ 207 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 4 | Botany - I | BCBZ 208 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 5 | Botany - II | BCBZ 209 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 6 | Botany - III | BCBZ 210 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 7 | Zoology - I | BCBZ 211 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 8 | Zoology - II | BCBZ 212 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 9 | Zoology - III | BCBZ 213 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 10 | Chemistry Lab | BCBZ 252 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 |
| 11 | Botany Lab | BCBZ 253 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 |
| 12 | Zoology Lab | BCBZ 254 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 |
| | | | | **33** | **675** | **0** | **0** | **243** | **675** | **39** |

| | | |
|---|---|---|
| **Course Name- B.Sc. (CBZ) - 2nd Year** | | |
| **Course Code-[BCBZ 305]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | **B.Sc.(CBZ) - 2nd Year** | |
| | **[BCBZ 305]: Chemistry-I** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain coordination compounds (structure, bonding, isomerism) |
| | **CO 2** | Describe transition metal chemistry (oxidation states, complexes). |
| | **CO 3** | Understand organometallic chemistry (structure, reactions). |
| | **CO 4** | Analyze biochemical applications of coordination compounds. |
| | **CO 5** | Apply chemical principles to predict reaction outcomes. |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Definition and scope of transition metals / 4 Hours Per Week |
| | **3** | Unit-3/ Introduction to 2nd and 3rd Transition Metals / 5 Hours Per Week |
| | **4** | Unit-4/ Introduction to Combination Compounds / 5 Hours Per Week |
| | **5** | Unit-5/ Lanthanides and Actinides / 5 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Definition and scope of transition metals, Electronic configuration and oxidation states, General physical and chemical properties, Classification of transition metals<br>Chemistry of Sc, Ti, V, Cr, Mn, Scandium, Titanium, Vanadium, Chromium, Manganese, Compounds and reactions of Sc, Ti, V, Cr, and Mn, Applications of Sc, Ti, V, Cr, and Mn, Trends and patterns in the chemistry of Sc, Ti, V, Cr, and Mn<br><br>Chemistry of Fe, Co, Ni, Cu, and Zn : Chemistry of Iron, Cobalt, Nickel, Copper, Zinc, Compounds and reactions of Fe, Co, Ni, Cu, and Zn |
| | **Module-3** | Introduction to 2nd and 3rd Transition Metals : Definition and scope of 2nd and 3rd transition metals, Electronic configuration and oxidation states, General physical and chemical properties, Classification of 2nd and 3rd transition metals<br>Chemistry of Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, and Cd<br>Chemistry of La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au |

| | | |
|---|---|---|
| | **Module-4** | Introduction to Combination Compounds: Definition and classification of combination compounds<br>Importance of combination compounds,<br>Coordination Compounds: Introduction to coordination compounds, Coordination numbers and geometry, Ligands and coordination spheres, Isomerism in coordination compounds, Stability and reactivity of coordination compounds |
| | **Module-5** | **Lanthanides and Actinides :** Definition and classification of lanthanides and actinides, Electronic configuration of lanthanides and actinides<br><br>**Chemistry of Lanthanides:** Physical and chemical properties of lanthanides, Separation and purification of lanthanides, Compounds of lanthanides (halides, oxides, etc.), Reactions of lanthanides (redox, complexation, etc.), Applications of lanthanides (catalysts, magnets, etc.), Biological importance of lanthanides, Advanced topics in lanthanide chemistry<br><br>**Chemistry of Actinides**: Physical and chemical properties of actinides, Separation and purification of actinides, Compounds of actinides (halides, oxides, etc.), Reactions of actinides (redox, complexation, etc.), Applications of actinides (nuclear energy, etc.), Biological importance of actinides, Advanced topics in actinide chemistry |
| | **Module-6** | **Introduction to Oxidation and Reduction:** Definition, classification & Historical background of oxidation and reduction<br>**Principles of Oxidation-Reduction Reactions:** Oxidation numbers and oxidation states, Electron transfer and oxidation-reduction reactions, Acid-base chemistry and oxidation-reduction reactions, Complexation and oxidation-reduction reactions<br>**Mechanisms of Oxidation-Reduction Reactions:** Single-electron & Two-electron transfer mechanisms, Free radical mechanisms, Chain reactions and oxidation-reduction reactions, Catalysis and oxidation-reduction reactions, Biological mechanisms of oxidation-reduction reactions |
| | | |
| | **Suggested Recommended Books:**<br>1. Physical Chemistry: An Introduction" by J. M. Seddon and J. D. Gale (Oxford University Press)<br>2. "Statistical Mechanics" by D. A. McQuarrie (University Science Books)<br>3. Physical Chemistry" by Peter W. Atkins (Oxford University Press)<br>4. "Physical Chemistry: A Molecular Approach" by D. A. McQuarrie and J. D. Simon (University Science Books)<br>5. "Physical Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International) | |

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|---|
| **Course Name- B.Sc. (CBZ) - 2nd Year** |
| **Course Code-[BCBZ 305]** |
| **Credits-6 (L-18 h/T-18h)** |

| | | |
|---|---|---|
| | **Course Outcomes (COs)** | |
| | **B.Sc. (CBZ) - 2nd Year** | |
| | **BCBZ 305**: **Chemistry-II** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain organic reaction mechanisms (substitution, elimination, addition) |
| | **CO 2** | Describe stereochemistry and its applications. |
| | **CO 3** | Understand organic synthesis (retrosynthesis, protecting groups). |
| | **CO 4** | Analyze spectroscopic methods (NMR, IR, MS). |
| | **CO 5** | Solve numerical problems involving organic chemistry |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/ Introduction /4 Hours Per Week** |
| | **2** | **Unit-2/** Ultraviolet Spectroscopy **/ 4 Hours Per Week** |
| | **3** | **Unit-3/ Alcohols / 5 Hours Per Week** |
| | **4** | **Unit-4/ Phenols / 5 Hours Per Week** |
| | **5** | **Unit-5/ Ethers Epoxides / 5 Hours Per Week** |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | **Ultraviolet Spectroscopy:** Introduction to UV Spectroscopy, Principles of UV Spectroscopy, Electronic transitions and UV spectroscopy, Molecular orbitals and UV spectroscopy, Selection rules and UV spectroscopy, Instrumental methods in UV spectroscopy, Sample preparation and UV spectroscopy, Data analysis and UV spectroscopy,<br>UV Spectral Analysis: Interpretation of UV spectra, Determination of molecular structure<br>Determination of chemical bonding<br><br>**Infrared spectroscopy**: Basic principles of IR spectroscopy, Instrumentation used in IR spectroscopy, Molecular vibrations and IR spectroscopy, IR active and inactive vibrations, Selection rules and IR spectroscopy, Instrumental methods in IR spectroscopy, Sample preparation and IR spectroscopy, Data analysis and IR spectroscopy |

| | | |
|---|---|---|
| | **Module-3** | **Alcohols:** Properties and Reactions of Alcohols , Acid-base properties of alcohols, Oxidation reactions of alcohols, Reduction reactions of alcohols, Substitution reactions of alcohols, Elimination reactions of alcohols, Reaction mechanisms of alcohols<br><br>**Synthesis and Characterization of Alcohols:** Synthesis of alcohols from alkyl halides, Synthesis of alcohols from alkenes, Synthesis of alcohols from carbonyl compounds, Characterization of alcohols using IR spectroscopy, Characterization of alcohols using NMR spectroscopy, Characterization of alcohols using mass spectrometry |
| | **Module-4** | **Phenols:** Acid-base properties of phenols, Oxidation reactions of phenols, Reduction reactions of phenols, Substitution reactions of phenols, Elimination reactions of phenols, Reaction mechanisms of phenols<br>**Synthesis and Characterization of Phenols:** Synthesis of phenols from benzene, Synthesis of phenols from alkylbenzenes, Synthesis of phenols from carbonyl compounds, Characterization of phenols using IR spectroscopy, Characterization of phenols using NMR spectroscopy, Characterization of phenols using mass spectrometry |
| | **Module-5** | **Ethers Epoxides:** Definition and classification of ethers, Nomenclature of ethers, Physical and chemical properties of ethers<br>**Properties and Reactions of Ethers:** Acid-base properties of ethers, Oxidation reactions of ethers, Reduction reactions of ethers, Substitution reactions of ethers, Elimination reactions of ethers, Reaction mechanisms of ethers<br><br>**Epoxides:** Definition, classification & Nomenclature of epoxides**,** Physical and chemical properties of epoxides, Synthesis of epoxides, Reactions of epoxides, Synthesis of ethers and epoxides, Characterization of ethers and epoxides using IR spectroscopy, Characterization of ethers and epoxides using NMR spectroscopy, Characterization of ethers and epoxides using mass spectrometry |
| | **Module-6** | **Aldehydes and Ketones:** Definition and classification of aldehydes, Nomenclature of aldehydes<br>Physical and chemical properties of aldehydes, Acid-base properties of aldehydes, Oxidation reactions of aldehydes, Reduction reactions of aldehydes, Substitution reactions of aldehydes, Elimination reactions of aldehydes, Reaction mechanisms of aldehydes<br>Ketones: Definition and classification of ketones, Nomenclature of ketones, Physical and chemical properties of ketones, Synthesis of ketones, Reactions of ketones, Application of ketones in industry |

| | | |
|---|---|---|
| | **Module-7** | **Aldehydes and Ketones:** Definition and classification of aldehydes, Nomenclature of aldehydes<br>Physical and chemical properties of aldehydes, Acid-base properties of aldehydes, Oxidation reactions of aldehydes, Reduction reactions of aldehydes, Substitution reactions of aldehydes, Elimination reactions of aldehydes, Reaction mechanisms of aldehydes<br>Ketones: Definition and classification of ketones, Nomenclature of ketones, Physical and chemical properties of ketones, Synthesis of ketones, Reactions of ketones, Application of ketones in industry<br><br>**Synthesis and Characterization :** Synthesis of aldehydes and ketones, Characterization of aldehydes and ketones using IR spectroscopy, Characterization of aldehydes and ketones using NMR spectroscopy, Characterization of aldehydes and ketones using mass spectrometry |
| | **Module-8** | **Carboxylic Acids:** Definition, classification & Nomenclature of carboxylic acids, Physical and chemical properties of carboxylic acids<br>Properties and Reactions of Carboxylic Acids: Acid-base properties of carboxylic acids, Oxidation reactions of carboxylic acids, Reduction reactions of carboxylic acids, Substitution reactions of carboxylic acids, Elimination reactions of carboxylic acids, Reaction mechanisms of carboxylic acids, Synthesis of carboxylic acids from alcohols, Synthesis of carboxylic acids from aldehydes and ketones<br>Synthesis of carboxylic acids from alkyl halides |
| | **Module-9** | **Organic compound of nitrogen:** Definition and classification of organic compounds of nitrogen, Nomenclature of organic compounds of nitrogen, Physical and chemical properties of organic compounds of nitrogen, Acid-base properties of amines, Oxidation and reduction reactions of amines, Substitution and elimination reactions of amines, Reaction mechanisms of amines |
| | | |
| | **Suggested Recommended Books:**<br>1. 1. Organic Chemistry" by Jerry March et al. (Wiley-Interscience)<br>2. "Organic Chemistry: An Introduction" by J. Clayden et al. (Oxford University Press)<br>3. "Advanced Organic Chemistry" by Francis A. Carey and Richard J. Sundberg (McGraw-Hill Education)<br>4Inorganic Chemistry" by James E. Huheey (HarperCollins Publishers)<br>5. "Inorganic Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International)<br>6. "Advanced Inorganic Chemistry" by Cotton and Wilkinson (Wiley-Interscience) | |

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|---|---|
| **Course Name- B.Sc. (CBZ) - 2nd Year** | |
| **Course Code-[BCBZ 305]** | |
| **Credits-6 (L-18 h/T-18h)** | |
| | **Course Outcomes (COs)** |
| | **B.Sc.(CBZ) - 2nd Year** |

| | | |
|---|---|---|
| | **BCBZ 305**: Chemistry - III | |
| | **Students will be able to:** | |
| | **CO 1** | Explain laws of thermodynamics (zeroth, first, second, third). |
| | **CO 2** | Describe chemical kinetics (rate laws, reaction mechanisms). |
| | **CO 3** | Understand quantum mechanics principles (wave-particle duality, uncertainty). |
| | **CO 4** | Analyze statistical mechanics principles (microcanonical, canonical). |
| | **CO 5** | Analyze and interpret experimental data related to physical chemistry. |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/** Introduction **/4 Hours Per Week** |
| | **2** | **Unit-2/ Thermodynamics I / 4 Hours Per Week** |
| | **3** | **Unit-3/ Thermodynamics II / 5 Hours Per Week** |
| | **4** | **Unit-4/ Phase Equilibrium / 5 Hours Per Week** |
| | **5** | **Unit-5/ Liquid Liquid Mixture / 5 Hours Per Week** |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | **Thermodynamics I-** Definition and scope of thermodynamics, Thermodynamic systems and surroundings**,** Thermodynamic properties (temperature, pressure, volume)**,** Thermodynamic processes (isothermal, adiabatic, isobaric)<br><br>**First Law of Thermodynamics**: Statement of the First Law, Concept of internal energy<br>Relationship between heat, work, and internal energy, Mathematical formulation of the First Law, Energy transformations and conservation, Calculation of changes in internal energy. Heat transfer and work<br><br>**Thermochemistry**: Definition and scope of thermochemistry, Laws of Thermochemistry,<br>First Law of Thermochemistry (conservation of energy), Internal energy and enthalpy<br>Hess's Law, Kirchhoff's equation, Applications of laws of thermochemistry<br><br>**Thermochemical Calculations:** Standard enthalpy changes, Calculation of internal energy and enthalpy, Application of Hess's Law, Thermodynamic data analysis |

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| | **Module-3** | **Thermodynamics II- Second Law of Thermodynamics:** Statement of the Second Law, Clausius inequality, Kelvin-Planck statement, Clausius-Clapeyron equation, Applications of the Second Law, Entropy changes for thermodynamic processes, Direction of spontaneous processes<br><br>**Thermodynamic Cycles :** Carnot cycle, Rankine cycle, Otto cycle, Thermodynamic efficiency<br>**Concept of Entropy:** Definition and units of entropy, Entropy change and heat transfer, Entropy change equations (Clausius, Gibbs), Isothermal, adiabatic, and isobaric processes<br>Phase transitions and entropy, Entropy changes in thermodynamic cycles, Entropy and thermodynamic efficiency<br><br>**Third Law of Thermodynamics:** Statement of the Third Law, Entropy at absolute zero<br>Implications of the Third Law, Applications of the Third Law, Thermodynamic systems at low temperatures, Entropy changes at low temperatures<br>**Chemical Equilibrium:** Equilibrium Constant & free energy, Thermodynamics derivation of law of mass action, Reaction isotherm & reaction isochore, |
| | **Module-4** | **Phase Equilibrium :** Definition and concept of phase equilibrium, Types of phase equilibrium, Phase rule, Statement of phase rule, Calculation of number of phases and components, Phase rule expressions, Phase rule in binary systems & ternary systems<br><br>**Phase Equilibrium of Two-Component Systems:** Statement of phase rule for two-component systems, Calculation of number of phases and components, Phase rule expressions, Phase rule in binary systems, Phase rule in ideal and non-ideal solutions<br><br>**Solid Solutions:** Definition and concept of solid solutions, Classification of solid solutions, Characteristics of solid solutions (lattice parameters, etc.), Effects of composition on solid solution properties, Solid solution microstructure & formation mechanisms, Thermodynamic principles governing solid solution formation, Influence of temperature and pressure on solid solution stability |

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| | **Module-5** | **Liquid liquid Mixture:** Definition and concept of liquid-liquid mixtures, Types of liquid-liquid mixtures, Thermodynamic modeling of liquid-liquid mixtures, Liquid-liquid equilibrium data analysis, Liquid-liquid equilibrium data analysis, Liquid-liquid phase transitions, Equipment design for liquid-liquid extraction, Operating conditions for liquid-liquid extraction |
| | | |
| | **Suggested Recommended Books:**<br>1. Physical Chemistry" by Peter W. Atkins (Oxford University Press)<br>2. "Physical Chemistry: A Molecular Approach" by D. A. McQuarrie and J. D. Simon (University Science Books)<br>3. "Physical Chemistry: Principles and Applications" by R. K. Yalamanchili (New Age International)<br>4. "Physical Chemistry: An Introduction" by J. M. Seddon and J. D. Gale (Oxford University Press)<br>5. "Statistical Mechanics" by D. A. McQuarrie (University Science Books) | |

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|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ308]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ308]: **-Botony-I** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of plant anatomy and morphology. |
| | **CO 2** | Describe the structure and function of plant cells and tissues. |
| | **CO 3** | Understand the process of photosynthesis and respiration in plants. |
| | **CO 4** | Analyze the diversity of plant families and their characteristics. |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/ Introduction /4 Hours Per Week** |
| | **2** | **Unit-2/** Plant Anatomy **/ 4 Hours Per Week** |
| | **3** | **Unit-3/ Plant Morphology / 5 Hours Per Week** |
| | **4** | **Unit-4/ Photosynthesis and Respiration / 5 Hours Per Week** |
| | **5** | **Unit-4/** Plant Diversity **/ 5 Hours Per Week** |

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|---|---|---|
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Plant Anatomy: Plant cell structure and function, Tissue organization and differentiation, Meristems and plant growth |
| | **Module-3** | Plant Morphology: Root and stem anatomy, Leaf and flower morphology, Fruit and seed development |
| | **Module-4** | Photosynthesis and Respiration : Light-dependent reactions, Light-independent reactions, Respiration and energy production |
| | **Module-5** | Plant Diversity : Plant classification and phylogeny, Characteristics of major plant families, Plant evolution and adaptation |
| | | |
| | **Suggested Recommended Books:**<br>1. Plant Anatomy by A. Fahn<br>2. Plant Morphology by R. C. Sharma<br>3. Photosynthesis by D. O. Hall | |

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|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ309]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ308]: **-Botony-II** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of plant physiology and biochemistry. |
| | **CO 2** | Describe the processes of plant growth and development. |
| | **CO 3** | Understand the mechanisms of plant defense and stress responses. |
| | **CO 4** | Analyze the role of plants in ecology and conservation. |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/ Introduction /4 Hours Per Week** |
| | **2** | **Unit-2/** Plant Physiology **/ 4 Hours Per Week** |
| | **3** | **Unit-3/** Plant Growth and Development **/ 5 Hours Per Week** |
| | **4** | **Unit-4/** Plant Defense and Stress Responses **/ 5 Hours Per Week** |
| | **5** | **Unit-4/** Plant Ecology and Conservation **/ 5 Hours Per Week** |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |

| | | |
|---|---|---|
| | **Module-2** | Plant Physiology : Water relations and transport, Mineral nutrition and transport, Photosynthesis and respiration |
| | **Module-3** | Plant Growth and Development: Hormone regulation of growth and development, Cell division and differentiation, Tissue and organ development |
| | **Module-4** | Plant Defense and Stress Responses : Mechanisms of plant defense against pathogens, Plant responses to abiotic stress, Plant stress physiology |
| | **Module-5** | Plant Ecology and Conservation : Plant ecology and ecosystems Plant conservation and biodiversity, Ecological restoration and management |
| | | |
| | **Suggested Recommended Books:**<br>1. Plant Physiology by L. Taiz and E. Zeiger<br>2. Plant Growth and Development by P. J. Davies<br>3. Plant Defense and Stress Responses by R. K. Singh | |

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|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ308]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ308]: **-Botony-II** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of plant ecology and conservation. |
| | **CO 2** | Describe the processes of plant evolution and diversity. |
| | **CO 3** | Understand the mechanisms of plant defense and stress responses. |
| | **CO 4** | Analyse the role of plants in ecosystem services and human well-being. |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Plant Ecology / 4 Hours Per Week |
| | **3** | Unit-3/ Plant Evolution and Diversity / 5 Hours Per Week |
| | **4** | Unit-4/ Plant Defence and Stress Responses / 5 Hours Per Week |
| | **5** | Unit-4/ Ecosystem Services and Human Well-being / 5 Hours Per Week |
| | **Detailed Syllabus** | |

| | | |
|---|---|---|
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Plant Ecology : Plant communities and ecosystems, Plant population ecology, Plant community ecology |
| | **Module-3** | Plant Evolution and Diversity : Mechanisms of plant evolution Plant phylogeny and systematics, Plant diversity and conservation |
| | **Module-4** | Plant Defense and Stress Responses :Mechanisms of plant defense against pathogens, Plant responses to abiotic stress, Plant stress physiology |
| | **Module-5** | Ecosystem Services and Human Well-being : Ecosystem services and human well-being, Plant-based solutions for ecosystem services, Sustainable use of plant resources |
| | | |
| | **Suggested Recommended Books:**<br>1. Plant Ecology by M. C. F. Proctor<br>2. Plant Evolution and Diversity by P. H. Raven<br>3. Plant Defense and Stress Responses by R. K. Singh | |

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|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ310]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ310]: **-Botony-III** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of plant biotechnology and genetic engineering. |
| | **CO 2** | Describe the processes of plant tissue culture and micropropagation. |
| | **CO 3** | Understand the mechanisms of plant molecular biology and genomics. |
| | **CO 4** | Analyze the applications of plant biotechnology in agriculture and industry. |
| | **CO 5** | Collect data and interpret results from plant biotechnology experiments. |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/ Introduction /4 Hours Per Week** |
| | **2** | **Unit-2/ Plant Biotechnology / 4 Hours Per Week** |
| | **3** | **Unit-3/ Plant Molecular Biology / 5 Hours Per Week** |
| | **4** | **Unit-4/ Plant Genetic Engineering / 5 Hours Per Week** |
| | **5** | **Unit-4/ Plant Biotechnology / 5 Hours Per Week** |
| | **Detailed Syllabus** | |

| | | |
|---|---|---|
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Plant Biotechnology: Introduction to plant biotechnology, Plant genetic engineering, Plant tissue culture and micropropagation |
| | **Module-3** | Plant Molecular Biology :Plant genome organization and structure Plant gene expression and regulation, Plant molecular markers and genomics |
| | **Module-4** | Plant Genetic Engineering : Principles of genetic engineering Plant transformation and regeneration, Gene editing and genome editing |
| | **Module-5** | Plant Biotechnology: Plant biotechnology in agriculture Plant biotechnology in industry, Plant biotechnology in medicine |
| | | |
| | **Suggested Recommended Books:**<br>1. Animal Physiology by R. L. Kotpal<br>2. Animal Development and Growth by S. F. Gilbert<br>3. Animal Behavior and Ecology by J. R. Krebs | |

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|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ313]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ313]: **Zoology-I** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of animal diversity and evolution. |
| | **CO 2** | Describe the characteristics of major animal phyla. |
| | **CO 3** | Understand the mechanisms of animal development and growth. |
| | **CO 4** | Analyze the diversity of animal habitats and ecosystems. |
| | **CO 5** | Apply knowledge of animal diversity and ecology to solve problems. |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/ Introduction /4 Hours Per Week** |
| | **2** | **Unit-2/** Animal Diversity and Evolution **/ 4 Hours Per Week** |
| | **3** | **Unit-3/** Characteristics of Major Animal Phyla **/ 5 Hours Per Week** |
| | **4** | **Unit-4/** Animal Development and Growth **/ 5 Hours Per Week** |
| | **5** | **Unit-5/** Animal Habitats and Ecosystems **/ 5 Hours Per Week** |
| | **Detailed Syllabus** | |

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|---|---|---|
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Animal Diversity and Evolution: Introduction to animal diversity Mechanisms of evolution, Phylogenetic relationships among animal phyla |
| | **Module-3** | Characteristics of Major Animal Phyla : Characteristics of Porifera and Coelenterata, Characteristics of Platyhelminthes and Nematoda Characteristics of Annelida and Arthropoda |
| | **Module-4** | Animal Development and Growth : Embryonic development Fetal development and birth, Postnatal growth and development |
| | **Module-5** | Animal Habitats and Ecosystems : Introduction to animal habitats and ecosystems, Terrestrial and freshwater ecosystems, Marine ecosystems and conservation |
| | | |
| | **Suggested Recommended Books:**<br>1. Animal Diversity and Evolution by R. S. K. Barnes<br>2. Invertebrate Zoology by E. E. Ruppert<br>3. Animal Development and Growth by S. F. Gilbert | |

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|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ312]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ312]: **Zoology-II** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of animal physiology and biochemistry. |
| | **CO 2** | Describe the processes of animal nutrition and digestion. |
| | **CO 3** | Understand the mechanisms of animal respiration and circulation. |
| | **CO 4** | Analyze the diversity of animal behavior and ecology. |
| | **CO 5** | Apply knowledge of animal physiology and ecology to solve problems. |
| | **Course Outline (CO)** | |
| | **1** | **Unit-1/ Introduction /4 Hours Per Week** |
| | **2** | **Unit-2/** Animal Physiology **/ 4 Hours Per Week** |
| | **3** | **Unit-3/** Animal Nutrition and Digestion **/ 5 Hours Per Week** |
| | **4** | **Unit-4/** Animal Respiration and Circulation **/ 5 Hours Per Week** |
| | **5** | **Unit-5/** Animal Behavior and Ecology **/ 5 Hours Per Week** |

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|---|---|---|
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Animal Physiology : Introduction to animal physiology, Nervous and muscular systems, Circulatory and respiratory systems |
| | **Module-3** | Animal Nutrition and Digestion : Introduction to animal nutrition Digestion and absorption of nutrients, Nutritional disorders and deficiencies |
| | **Module-4** | Animal Respiration and Circulation : Introduction to animal respiration, Gas exchange and transport, Circulatory system and blood |
| | **Module-5** | Animal Behavior and Ecology : Introduction to animal behavior Behavioral adaptations and evolution, Ecological principles and conservation |
| | | |
| | **Suggested Recommended Books:**<br>**1.** Animal Physiology by R. L. Kotpal<br>2. Animal Nutrition and Digestion by P. J. Reeds<br>3. Animal Respiration and Circulation by W. D. Hardison | |

| | | |
|---|---|---|
| **Course Name-** B.Sc.(BCBZ) - 2nd Year | | |
| **Course Code-[BCBZ312]** | | |
| **Credits-6 (L-18 h/T-18h)** | | |
| | **Course Outcomes (COs)** | |
| | B.Sc.(BCBZ) - 2nd Year | |
| | [BCBZ312]: **Zoology-III** | |
| | **Students will be able to:** | |
| | **CO 1** | Explain the principles of animal physiology and biochemistry. |
| | **CO 2** | Describe the processes of animal nutrition and digestion. |
| | **CO 3** | Understand the mechanisms of animal respiration and circulation. |
| | **CO 4** | Analyze the diversity of animal behavior and ecology. |
| | **CO 5** | Apply knowledge of animal physiology and ecology to solve problems. |
| | **Course Outline (CO)** | |
| | **1** | Unit-1/ Introduction /4 Hours Per Week |
| | **2** | Unit-2/ Animal Physiology / 4 Hours Per Week |
| | **3** | Unit-3/ Animal Nutrition and Digestion / 5 Hours Per Week |
| | **4** | Unit-4/ Animal Respiration and Circulation / 5 Hours Per Week |

| | | |
|---|---|---|
| | **5** | Unit-5/ Animal Behavior and Ecology / 5 Hours Per Week |
| | **Detailed Syllabus** | |
| | **Module-1** | Introduction to objective, scope and outcome of the course. |
| | **Module-2** | Animal Physiology: Introduction to animal physiology<br>Nervous and muscular systems, Circulatory and respiratory systems |
| | **Module-3** | Animal Nutrition and Digestion :Introduction to animal nutrition<br>Digestion and absorption of nutrients, Nutritional disorders and deficiencies |
| | **Module-4** | Animal Respiration and Circulation : Introduction to animal respiration, Gas exchange and transport, Circulatory system and blood |
| | **Module-5** | Animal Behavior and Ecology : Introduction to animal behavior<br>Behavioral adaptations and evolution, Ecological principles and conservation |
| | | |
| | **Suggested Recommended Books:**<br>1. Animal Physiology by R. L. Kotpal<br>2. Animal Nutrition and Digestion by P. J. Reeds<br>3. Animal Respiration and Circulation by W. D. Hardison | |

# UNIVERSITY OF TECHNOLOGY, JAIPUR

**Syllabus**

**2nd Year B.Sc. (CBZ) - July-2022)**

## Chemistry Lab [BCBZ 252]

**Credit 1** **Max. Marks: 100(IA: 60, ETE: 40)**

**0L+0T+2P**

| List of Experiments | |
|---|---|
| 1 | Preparation of standard solution |
| 2 | Volumetric Analysis |
| 3 | Gravimetric Analysis |
| 4 | Thin layer chromatography |
| 5 | Separation of green leaf pigments |
| 6 | Separation of a mixture of dyes using cyclohexane & ethyl estate |
| 7 | Qualitative analysis- Identification of two organic compound through the functional group analysis |

## Botony Lab [BCBZ 253]

**Credit 1** **Max. Marks: 100(IA: 60, ETE: 40)**

**0L+0T+2P**

| List of Experiments | |
|---|---|
| 1 | Plant Anatomy: Study of plant cells and tissues, Identification of plant organs and structures |
| 2 | Plant Morphology: Study of plant habit and growth forms, Identification of plant families and genera |
| 3 | Plant Physiology: Study of photosynthesis and respiration, Measurement of plant growth and development |
| 4 | Plant Ecology : Study of plant communities and ecosystems, Analysis of plant diversity and conservation |

## Zoology Lab [BCBZ 254]

**Credit 1** **Max. Marks: 100(IA: 60, ETE: 40)**

**0L+0T+2P**

| List of Experiments | |
|---|---|
| 1 | Animal Diversity and Evolution: Study of animal phyla and classes, Identification of animal specimens |
| 2 | Animal Physiology: Study of animal systems (nervous, circulatory, respiratory), Measurement of physiological parameters |
| 3 | Animal Biochemistry: Study of animal metabolism and bioenergetics, Analysis of biochemical compounds |
| 4 | Animal Ecology : Study of animal habitats and ecosystems, Analysis of ecological principles and conservation |

UNDERGRADUATE DEGREE COURSE

# Bachelor of Science (CBZ)

## 3rd Year

# University of Technology

## Vatika Road, Jaipur

## Rajasthan 303903

| B.Sc. (CBZ) - 3rd Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Subject Name** | **Subject Code** | **Subject Type** | **Credit Point** | **Tot. Max Marks** | **Int. Min Marks** | **Int. Max Marks** | **Ext. Min Marks** | **Ext. Max Marks** | **Teach Hours** |
| 1 | Chemistry - I | BCBZ 305 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 2 | Chemistry - II | BCBZ 306 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 3 | Chemistry - III | BCBZ 307 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 4 | Botany - I | BCBZ 308 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 5 | Botany - II | BCBZ 309 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 6 | Botany - III | BCBZ 310 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 7 | Zoology - I | BCBZ 311 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 8 | Zoology - II | BCBZ 312 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 9 | Zoology - III | BCBZ 313 | Theoretical | 3 | 50 | 0 | 0 | 18 | 50 | 3 |
| 10 | Chemistry Lab | BCBZ 352 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 |
| 11 | Botany Lab | BCBZ 353 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 |
| 12 | Zoology Lab | BCBZ 354 | Practical | 2 | 75 | 0 | 0 | 27 | 75 | 4 |

*L: Lecture, T: Tutorial, P: Practical, Cr: Credits*

*ETE: End Term Exam, IA: Internal Assessment*

| | |
|---|---|
| **Course Name-** B.Sc.(BCBZ) – 3rd Year | |
| **Course Code-[BCBZ305]** | |
| **Credits-6 (L-18 h/T-18h)** | |
| | B.Sc.(BCBZ) – 3rd Year |
| | [BCBZ305]: **Chemistry-I** |

| | |
|---|---|
| Course Outcomes (COs) | |
| CO 1 | Describe **Metal-ligand bonding in transition metal complexes** |
| CO 2 | Describe **Magnetic properties of transition metal complexes** |
| CO 3 | Explain **Organometallic Chemistry** |
| CO 4 | Describe **Bioinorganic chemistry** |
| CO 5 | Explain **Bioinorganic chemistry** |
| Course Outline (CO) | |
| 1 | Unit-1/ **Metal-ligand bonding in transition metal complexes** /7 Hours Per Week |
| 2 | Unit-2/ **Magnetic properties of transition metal complexes** / 6 Hours Per Week |
| 3 | Unit-3/ **Organometallic Chemistry** / 6 Hours Per Week |
| 4 | Unit-4/ **Bioinorganic chemistry** / 7 Hours Per Week |
| 5 | Unit-5/ **Bioinorganic chemistry** / 6 Hours Per Week |
| Detailed Syllabus | |
| Module-1 | **Metal-ligand bonding in transition metal complexes:** (A) Limitations of valence bond theory, Limitation of Crystal Field Theory, Application of CFSE, tetragonal distortions from octahedral geometry, Jahn–Teller distortion, square planar geometry. Qualitative aspect of Ligand field and MO Theory. (B) Thermodynamic and kinetic aspects of metal complexes. A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes, Trans- effect, theories of trans effect. Mechanism of substitution reactions of square planar complexes. |
| Module-2 | **Magnetic properties of transition metal complexes:** Types of magnetic behavior, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of μso (spin only) and μeff. values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes. Electronic spectra of Transition Metal Complexes. Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d1 and d2 states, discussion of the electronic spectrum of [Ti(H2O)6] 3+ complex ion. |

| | | |
|---|---|---|
| | Module-3 | **Organometallic Chemistry:** Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18-electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. πacceptor behavior of CO (MO diagram of CO to be discussed), Zeise's salt: Preparation and structure |
| | Module-4 | **Bioinorganic chemistry**: Essential and trace elements in biological processes, Excess and deficiency of some trace metals, Toxicity of some metal ions (Hg, Pb, Cd and As), metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca2+ and Mg2+ , nitrogen fixation. |
| | Module-5 | **Hard and soft acids and bases** (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, Applications of HSAB principle. INORGANIC POLYMERS Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones. Silicates, phosphazenes and polyphosphate. |
| | **Reference Books** | |
| | 1 | Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson and P. L. Gaus, Wiley. 2. Concise Inorganic Chemistry, J. D. Lee, ELBS. 3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J. Alexander, John Wiley. 4. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. Langford, Oxford. 5. Inorganic Chemistry, W. W. Porterfield, Addison – Wiley. 6. Inorganic Chemistry, A. G. Sharp, ELBS. 7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall. 8. Advanced Inorganic Chemistry, Satya Prakash. |
| | | |

Course Name- Chemistry - II

Course Code- BCBZ306

Credits-3 (L-18 h/T-18h)

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|---|---|---|
| | Course Outcomes (COs) | |
| | CO 1 | Discuss about HETEROCYCLIC COMPOUNDS |
| | CO 2 | Describe substitution, elimination, and addition reactions |
| | CO 3 | Explain stereochemistry and regioselectivity |
| | CO 4 | Analyze SYNTHETIC POLYMERS |
| | CO 5 | Explain SPECTROSCOPY |
| | Course Outline (CO) | |
| | 1 | Unit-1/ HETEROCYCLIC COMPOUNDS /6 Hours Per Week |

| | | |
|---|---|---|
| | 2 | Unit-2/ ORGANOMETALLIC REAGENT / 6 Hours Per Week |
| | 3 | Unit-3/ BIOMOLECULES / 5 Hours Per Week |
| | 4 | Unit-4/ SYNTHETIC POLYMERS / 6 Hours Per Week |
| | 5 | Unit-5/ SPECTROSCOPY / 6 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | HETEROCYCLIC COMPOUNDS: Classification and nomenclature, Structure, aromaticity in 5-membered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Indole (Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler-Napieralski reaction, Pictet- Spengler reaction, Pomeranz-Fritsch reaction). |
| | Module-2 | ORGANOMETALLIC REAGENT Organomagnesium compounds: Grignard reagents formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions. B. ORGANIC SYNTHESIS VIA ENOLATES Active methylene group, alkylation of diethylmalonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate: The Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Robbinson annulations reaction. |
| | Module-3 | BIOMOLECULES A. CARBOHYDRATES Occurrence, classification and their biological importance. Monosaccharides: relative and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani Fischer synthesis and Ruff degradation; Disaccharides – Structural comparison of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch and cellulose. B. AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS Classification and Nomenclature of amino acids, Configuration and acid base properties of amino acids, Isoelectric Point, Peptide bonds, Protein structure, denaturation/ renaturation, Constituents of nucleic acid, DNA, RNA nucleoside, nucleotides, double helical structure of DNA. |
| | Module-4 | **SYNTHETIC POLYMERS**<br>A. Addition or chain growth polymerization, Free radical vinyl polymerization, Ziegler-Natta polymerization, Condensation or Step growth polymerization, polyesters, polyamides, phenols- formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes, natural and synthetic rubbers.<br><br>B. SYNTHETIC DYES<br>Colour and constitution (Electronic Concept). Classification of Dyes. Chemistry of dyes. Chemistry and synthesis of Methyl Orange, Congo Red, Malachite Green, Crystal Violet, phenolphthalein, fluorescein, Alizarine and Indigo. |

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| | Module-5 | A. INFRA-RED SPECTROSCOPY Basic principle, IR absorption Band their position and intensity, IR spectra of organic compounds.<br><br>B. UV-VISIBLE SPECTROSCOPY Beer Lambert's law, effect of Conjugation, Types of electronic transitions λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption Visible spectrum and colour.<br><br>C. NMR SPECTROSCOPY Basic principles of Proton Magnetic Resonance, Tetramethyl silane (TMS) as internal standard, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant (J); Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple organic compounds. 13CMR spectroscopy: Principle and applications. |
| | **Recommended Books** | |
| | | 1. Organic Chemistry, Morrison and Boyd, Prentice-Hall.<br>2. Organic Chemistry, L. G. Wade Jr. Prentice Hall.<br>3. Fundamentals of Organic Chemistry, Solomons, John Wiley.<br>4. Organic Chemistry, Vol I, II, III S. M. Mukherjee, S. P. Singh and R. P. Kapoor, Wiley Easters (New Age).<br>5. Organic Chemistry, F. A. Carey, McGraw Hill.<br>6. Introduction to Organic Chemistry, Struiweisser, Heathcock and Kosover, Macmillan.<br>7. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Wiley & Sons (1976). |

Course Name- Chemistry - III

Course Code- BCBZ307

Credits-3 (L-18 h/T-18h)

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| | **Course Outcomes (COs)** | |
| | CO 1 | Describe retrosynthetic analysis and planning |
| | CO 2 | Explain functional group transformations and protection |
| | CO 3 | Analyze yield and purification methods |
| | CO 4 | Computational Analysis of ELECTROCHEMISTRY-I |
| | CO 5 | Computational Analysis of ELECTROCHEMISTRY-II |
| | **Course Outline (CO)** | |
| | 1 | Unit-1/ QUANTUM MECHANICS–I /4 Hours Per Week |
| | 2 | Unit-2/ QUANTUM MECHANICS–II / 4 Hours Per Week |
| | 3 | Unit-3/ SPECTROSCOPY / 5 Hours Per Week |

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| | 4 | Unit-4/ ELECTROCHEMISTRY-I / 5 Hours Per Week |
| | 5 | Unit-5/ ELECTROCHEMISTRY-II / 5 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | QUANTUM MECHANICS–I Black-body radiation, Planck's radiation law, photoelectric effect, Compton effect. Operator: Hamiltonian operator, angular momentum operator, Laplacian operator, postulate of quantum mechanics, eigen values, eigen function, Schrodinger time independent wave equation, physical significance of $\psi$ & $\psi$ 2 , application of Schrodinger wave equation to particle in a one dimensional box, hydrogen atom (separation into three equations ) radial and angular wave functions. |
| | Module-2 | QUANTUM MECHANICS–II Quantum Mechanical approach of Molecular orbital theory, basic ideas-criteria for forming M.O. and A.O., LCAO approximation, formation of H2 + ion, calculation of energy levels from wave functions, bonding and antibonding wave functions, Concept of $\sigma$, $\sigma^*$, $\pi$, $\pi^*$ orbitals and their characteristics, Hybrid orbitals-sp,sp2 ,sp3 Calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H2, comparison of M.O. and V.B. models. Huckel theory, application of Huckel theory to ethene, propene, etc. |
| | Module-3 | SPECTROSCOPY Introduction: Characterization of Electromagnetic radiation, regions of the spectrum, representation of spectra, width and intensity of spectral transition, Rotational Spectrum of Diatomic molecules. Energy levels of a rigid rotor, selection rules, determination of bond length, qualitative description of non-rigid rotator, isotopic effect. Vibrational Spectroscopy: Fundamental vibration and their symmetry vibrating diatomic molecules, Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, determination of force constant, anharmonic oscillator Raman spectrum: Concept of polarizability, quantum theory of Raman spectra, stokes and antistokes lines, pure rotational and pure vibrational Raman spectra. Applications of Raman Spectra. Electronic Spectroscopy: Basic principles, Electronic Spectra of diatomic molecule, Franck-Condon principle, types of electronic transition, application of electronic spectra |
| | Module-4 | ELECTROCHEMISTRY-I A. Electrolytic conductance: Specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. B. Theories of strong electrolyte: limitations of Ostwald’s dilution law, weak and strong electrolytes, Elementary ideas of Debye – Huckel - Onsager’s equation for strong electrolytes , relaxation and electrophoretic effects. C. Migration of ions: Transport number, Determination by Hittorf method and moving boundary method, ionic strength. |
| | Module-5 | ELECTROCHEMISTRY-II A. Electrochemical cell and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells, EMF of the cell and effect of temperature on EMF of the cell, Nernst equation Calculation of $\Delta G$, $\Delta H$ and $\Delta S$ for cell reactions. B. Single electrode potential : standard hydrogen electrode, calomel electrode, quinhydrone electrode, redox electrodes, electrochemical series C. Concentration cell with |

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| | | and without transport, liquid - junction potential, application of concentration cells in determining of valency of ions , solubility product and activity coefficient D. Corrosion-types , theories and prevention |
| | Reference Books | |
| | 1<br>2<br>3<br>4<br>5<br>6<br>7 | Physical chemistry, G.M.Barrow. International Student Edition McGraw Hill.<br>University General Chemistry, CNR Rao, Macmillan.<br>Physical Chemistry R.A.Alberty, Wiley Eastrn.<br>The elements of Physical Chemistry P.W.Alkin,Oxford.<br>Physical Chemistry through problems, S.K.Dogra, Wiley Eastern.<br>Physical Chemistry B.D.Khosla.<br>Physical Chemistry, Puri & Sharma |

Course Name- Botony-I

Course Code- BCBZ308

Credits-3 (L-18 h/T-18h)

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| | Course Outcomes (COs) | |
| | CO 1 | Structure and functions of the Nucleus: Ultrastructure, nuclear functions, and more |
| | CO 2 | Estimation of DNA, RNA, and protein |
| | CO 3 | Study of plant cells and tissues |
| | CO 4 | Identification of plant organs and structures |
| | Course Outline (CO) | |
| | 1 | Unit-1/ Definition /5 Hours Per Week |
| | 2 | Unit-2/ Biotechnology (Applied microbiology & Genetic engineering) / 6 Hours Per Week |
| | 3 | Unit-3/ Genetic Engineering / 7 Hours Per Week |
| | 4 | Unit-4/ Plant Pathology / 7 Hours Per Week |
| | 5 | Unit-5/ A brief history of anther and ovule /6 Hours Per Week |
| | 6 | Unit-6/ General account of Bryophytes /6 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | Biotechnology (Applied microbiology & Genetic engineering) Microbiology and Applied microbiology: Definition and scope: An elementary knowledge of soil, water, sewage, milk, food, air, and industrial microbiology; importance and application of Penicillium, Bacillus, Chlorella, Streptococcus, Lactobacillus, Leuconostoc, Saccharomyces, Aspergillus, Clostridium, and Claviceps; symbiotic and non-symbiotic nitrogen-fixing bacteria; and blue- |

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| | | green algae; Mycorrhiza |
| | Module-2 | Genetic Engineering: Concept & scope: gene transplant, role of restriction enzymes, endonucleases; plasmids in transferring gene; application of genetic engineering in medicine, agriculture, industry and environment |
| | Module-3 | Plant Pathology: Definition and scope: disease and disease-causing organisms; symptoms of plant diseases; dissemination of pathogens; introductory knowledge of epidemiology and forecasting of plant diseases; host-parasite interaction; effect of environment on plant diseases; principles of defence mechanisms and control |
| | Module-4 | A brief history of anther and ovule; Male gametophytes, Polygonum type of embryo sac; fertilization, development of embryo sac as exemplified by Capsella bursapastoris and Sagitaria type; An elementary account of the development of endosperm ; apomixes and polyembryony |
| | Module-5 | Bryophyta: A general account of Bryophytes; the life histories of the following genera:<br>Hepaticopsida: Riccia, Marchantia, Pellia, Porella<br>Anthocerotopsida: Anthoceros<br>Bryopsida: Sphagnum, Funaria |
| | **Recommended Books** | |
| | 1 | "Fungi" by M. J. Carlile - A comprehensive textbook on fungi, covering topics such as fungal structure, physiology, and ecology. |
| | 2 | "Lichens" by A. Fletcher - A detailed textbook on lichens, covering topics such as lichen structure, physiology, and ecology. |
| | 3 | "Plant Physiology" by L. Taiz and E. Zeiger - A comprehensive textbook on plant physiology, covering topics such as photosynthesis, respiration, and plant growth. |
| | 4 | "Plant Biochemistry" by P. M. Dey and J. B. Harborne - A textbook on plant biochemistry, covering topics such as plant metabolism, enzymes, and biochemical pathways. |

Course Name- Botony-II

Course Code- BCBZ309

Credits-3 (L-18 h/T-18h)

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| | Course Outcomes (COs) | |
| | CO 1 | Explain the principles of ecology, evolution, and conservation biology. |
| | CO 2 | Describe the diversity of animal behavior, including social behavior, communication, and learning. |
| | CO 3 | Understand the biology of wildlife, including population dynamics, community ecology, and ecosystem management. |
| | CO 4 | Analyze the principles of animal biotechnology, including genetic engineering and gene cloning. |
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| | Course Outline (CO) | |

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|---|---|---|
| | 1 | Unit-1/ Definition /5 Hours Per Week |
| | 2 | Unit-2/ Plant Pathology / 6 Hours Per Week |
| | 3 | Unit-3/ Applied Plant Anatomy and Plant Breeding Applied plant anatomy / 7 Hours Per Week |
| | 4 | Unit-4/ Plant Breeding / 7 Hours Per Week |
| | 5 | Unit-5/ Marine Biology and Limnology /6 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | Plant Pathology: Definition and scope: disease and disease-causing organisms; symptoms of plant diseases; dissemination of pathogens; introductory knowledge of epidemiology and forecasting of plant diseases; host-parasite interaction; effect of environment on plant diseases; principles of defence mechanisms and control, h) Rubber: Havea, Ficus i) Tannins: Acacia j) Gum: Acacia, Sterculia, k) Weeds and weed control: An introduction and definition of weeds; methods of weed control, a basic knowledge of herbicides, their transformation and persistence in soil; some prominent weeds of crop plants and their control |
| | Module-2 | Applied Plant Anatomy and Plant Breeding Applied plant anatomy: Economic aspect of applied plant anatomy in taxonomy, horticulture, food adulteration, medicinal plants; wood in present day archaeology, forensic application |
| | Module-3 | Plant Breeding: An elementary knowledge of plant breeding, methods of breeding of self-pollinated crops, cross-pollinated crops, and asexually propagated crops, parasexuality, techniques of plant breeding: emasculation, pollination etc |
| | Module-4 | Marine Biology and Limnology: An elementary knowledge of marine biology and limnology; a general study of morphological and reproductive features of micro and macrophytes growing in sea water with special reference to their adaptations; a preliminary knowledge of abiotic (Physicochemical properties of water) and biotic (planktons, periphytons, macrophytes, benthos and decomposes) factors influencing growth of fresh water and marine water flora |
| | **Recommended Books** | |
| | 1 | - Ecology" by Robert E. Ricklefs |
| | 2 | - "Evolution" by Mark Ridley |
| | 3 | - "Conservation Biology" by Gary K. Meffe |
| | 4 | - "Animal Behavior" by James L. Gould |
| | 5 | - Wildlife Biology" by Raymond F. Dasmann |
| | 6 | - "Animal Biotechnology" by David M. Glover |
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Course Name- Botony-III

Course Code- BCBZ310

Credits-3 (L-18 h/T-18h)

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| | Course Outcomes (COs) | |
| | CO 1 | Explain the principles of plant physiology, including photosynthesis, respiration, and plant growth. |
| | CO 2 | Describe the diversity of plant ecosystems, including forests, grasslands, and wetlands. |
| | CO 3 | Understand the concepts of ecological succession, community dynamics, and biodiversity. |
| | CO 4 | Analyze data and interpret data |
| | CO 5 | Compare, validate & conclude the results |
| | Course Outline (CO) | |
| | 1 | Unit-1/ Definition /5 Hours Per Week |
| | 2 | Unit-2/ PALAEOBOTANY / 6 Hours Per Week |
| | 3 | Unit-3/ PLANT DIVERSIFICATION / 7 Hours Per Week |
| | 4 | Unit-4/ Morphogenesis and Tissue Culture / 7 Hours Per Week |
| | 5 | Unit-5/ Types of life cycles /6 Hours Per Week |
| | 6 | Unit-6/ Ecology of Algae /6 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | **PALAEOBOTANY**: An elementary knowledge of Palaeobotany; geological era; process of fossilization; types of fossils; methods of fossil study; form genera and reconstruction of fossil plants PALYNOLOGY: An introductory knowledge of palynology |
| | Module-2 | **PLANT DIVERSIFICATION**: Evolutionary trends; origin and evolution of different plant groups |
| | Module-3 | **Morphogenesis and Tissue Culture:** Phenomenon of morphogenesis;; an elementary knowledge of polarity, symmetry; cellular and tissue differentiation; protoplast fusion, methodology and application of tissue culture |
| | Module-4 | **Types of life cycles** – Haplontic, Diplontic, Diplohaplontic, Haplodiplontic and Diplobiontic; Alternation of generation in Algae. |
| | Module-5 | **Ecology of Algae:** Brief idea of freshwater and marine, terrestrial, epiphytic, parasitic, symbiotic algae and phytoplanktons. Economic importance of algae as food, fodder, in agriculture, industry and public health. |
| | **Reference Books** | |
| | 1 | Plant Physiology" by L. Taiz and E. Zeiger |
| | 2 | "Ecology" by R. E. Ricklefs |
| | 3 | "Plant Ecology" by J. L. Harper |

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| Course Name- Botony III | | |
| Course Code- BCBZ310 | | |
| Credits-3 (L-18 h/T-18h) | | |
| | Course Outcomes (COs) | |
| | CO 1 | Explain the principles of genetics, molecular biology, and biotechnology. |
| | CO 2 | Describe the structure and function of cell and cell organelles. |
| | CO 3 | Understand the organization and morphology of chromosomes. |
| | CO 4 | Analyze the general characteristics of algae and its position in the plant kingdom. |
| | CO 5 | Apply knowledge of botany to solve problems |
| | Course Outline (CO) | |
| | 1 | Unit-1/ Structure and functions of Nucleus /5 Hours Per Week |
| | 2 | Unit-2/ Cell division / 6 Hours Per Week |
| | 3 | Unit-3/ Genetic Inheritance / 7 Hours Per Week |
| | 4 | Unit-4/ DNA-the genetic material / 7 Hours Per Week |
| | 5 | Unit-5/ Introduction to Biotechnology /6 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | Structure and functions of Nucleus: Ultra structure, nuclear membrane, nucleolus, structure and functions of other cell organelles: Golgi body, endoplasmic reticulum, peroxysomes and vacuoles. The cell envelope: Plasma membrane, bilayer lipid structure and functions of cell wall. |
| | Module-2 | Cell division: Comparasion of mitosis and meiosis<br>Chromosome organization: Morphology, centromere and telomere, chromosome alteration in chromosome numbers, aneuploidy, polyploidy and sex chromosomes.<br>Extra nuclear genome: Presence and functions of mitochondrial and plastid DNA, plasmids. |
| | Module-3 | Genetic Inheritance: Mendelism: Law of segregation and independent assortment, incomplete dominance.<br>Interaction of genes: Linkage- complete and incomplete linkage and crossing over. |
| | Module-4 | DNA-the genetic material: DNA structure, replication, DNA- protein interaction, the nucleosome model, satellite and repetitive DNA.<br>RNA: Structure and types.<br>Gene concept: Classical and modern concept of gene, operon concept. |

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| | Module-5 | Introduction to Biotechnology: Functional definition, role in modern life, history and ethical issues connected with biotechnology.<br>Genetic engineering: Tools and techniques of DNA technology, cloning vectors, genome, cDNA libraries, transposable elements and techniques of gene mapping |
| | **Reference Books** | |
| | 1 | Gupta P.K. 2000. Cytology, Genetics And Evolution. Rastogi Publication, Meerut |
| | 2 | Gupta P.K. 2012. Genetics. Rastogi Publication, Meerut |
| | 3 | Gupta P.K. 2001.Elements of Biotechnology. Rastogi Publication, Meerut |
| | 4 | Power, C.B. 1994. Cell Biology. Himalaya Publishing House, New Delhi |
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Course Name- Zoology I

Course Code- BCBZ311

Credits-3 (L-18 h/T-18h)

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| | Course Outcomes (COs) | |
| | CO 1 | Explain the principles of physiology, genetics, and molecular biology in animals. |
| | CO 2 | Describe the diversity of animal life, including non-chordates and chordates. |
| | CO 3 | Understand the biology of fish, including their anatomy, physiology, and behavior |
| | CO 4 | Analyze the principles of fisheries management and conservation |
| | CO 5 | Apply knowledge of zoology to solve problems |
| | Course Outline (CO) | |
| | 1 | Unit-1/ Definition /5 Hours Per Week |
| | 2 | Unit-2/ Physiology / 6 Hours Per Week |
| | 3 | Unit-3/ Respiration / 7 Hours Per Week |
| | 4 | Unit-4/ Sensory System / 7 Hours Per Week |
| | Detailed Syllabus | |
| | Module-1 | Physiology: Nutritive substances, Enzymes and Energetics: Biological role of nutritive substances. Metabolism and metabolic pathways. Bioenergetics. General properties and mechanism of action of enzymes. Cofactors and Coenzymes. Factors influencing enzyme activity<br>Digestion: Digestion and absorption of nutrient. Gastrointestinal secretions and its regulation |
| | Module-2 | Respiration: Respiratory mechanism. Respiratory pigments. Respiratory gases. Regulation of respiration. Circulation: Blood groups. Haemostasis and blood coagulation. Conduction system of the heart. Cardiac output and its control |

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| | Module-3 | Excretion: Excretion and excretory products in animals. Mechanism of urine formation. Role of kidney in the maintenance of electrolyte balance & pH.<br>Nervous System: Nerve cells and electrical signaling. Synaptic transmission and neuronal integration<br>Endocrine System: Primary endocrine glands, respective hormones and their functions. |
| | Module-4 | Sensory System: General principles of sensory physiology:- vision, hearing and balance, taste, smell and touch<br>Reproduction and Development: Female reproductive cycle (ovarian and uterine cycles in human). Gametogenesis. Types of eggs. Mechanism of fertilization. Embryonic development. |
| | **Recommended Books** | |
| | 1 | Fish Physiology" by David H. Evans - A comprehensive textbook on fish physiology, covering topics such as anatomy, physiology, and behavior. |
| | 2 | Fisheries Science: An Introduction" by Michael L. Peterson - A textbook on fisheries science, covering topics such as fisheries management, conservation, and ecology. |
| | 3 | Aquaculture: Principles and Practices" by T. V. R. Pillay - A textbook on aquaculture, covering topics such as fish farming, fisheries management, and conservation. |
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Course Name- Zoology II

Course Code- BCBZ312

Credits-3 (L-18 h/T-18h)

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| | Course Outcomes (COs) | |
| | CO 1 | Explain the principles of ecology, evolution, and conservation biology. |
| | CO 2 | Describe the diversity of animal behavior, including social behavior, communication, and learning. |
| | CO 3 | Understand the biology of wildlife, including population dynamics, community ecology, and ecosystem management. |
| | CO 4 | Analyze the principles of animal biotechnology, including genetic engineering and gene cloning. |
| | CO 5 | Apply knowledge of zoology to solve problems. |
| | Course Outline (CO) | |
| | 1 | Unit-1/ Introduction to Natural Resources and Management /5 Hours Per Week |
| | 2 | Unit-2/ Water Resource / 6 Hours Per Week |
| | 3 | Unit-3/ Land resource / 7 Hours Per Week |
| | 4 | Unit-4/ Mineral resource / 7 Hours Per Week |
| | 5 | Unit-5/ Biodiversity Resource /6 Hours Per Week |

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| | Detailed Syllabus | |
| | Module-1 | Introduction to Natural Resources and Management: Concept, values and types. Consumption trends and factors affecting resource use. Depletion and management of natural resource. Sustainable development. Policy and governance. |
| | Module-2 | Water Resource: Introduction. Hydrological cycles. Major sources of water. Use and depletion of water resources. State of water resources of Nepal. Water resource management. |
| | Module-3 | Land resource: Concept of land resource. Land use. Land resource degradation. Land resource management (Policy, planning and practice). |
| | Module-4 | Mineral resource: Introduction, types and importance of mineral resource. Consequence of mineral extraction, Status of major minerals in Nepal. Conservation of mineral resources. Mountain Resource: Mountain natural resource and their conservation |
| | Module-5 | Biodiversity Resource: Introduction, types and importance of biological resources. Concept of biodiversity. State and threats of biodiversity of Nepal. Management of biodiversity (ex-situ and in-situ) |
| | **Recommended Books** | |
| | 1 | "Ecology" by Robert E. Ricklefs |
| | 2 | "Evolution" by Mark Ridley |
| | 3 | "Conservation Biology" by Gary K. Meffe |
| | 4 | "Animal Behavior" by James L. Gould |
| | | |

Course Name- Zoology III

Course Code- BCBZ313

Credits-3 (L-18 h/T-18h)

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| | Course Outcomes (COs) | |
| | CO 1 | Discuss the principles of animal ecology, including ecosystem dynamics and conservation biology. |
| | CO 2 | Describe the concepts of animal biotechnology, including genetic engineering and gene cloning. |
| | CO 3 | Understand the applications of biotechnology in animal health and production. |
| | CO 4 | Analyze data and interpret results from study |

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| | Course Outline (CO) | |
| | 1 | Unit-1/ Definition /5 Hours Per Week |
| | 2 | Unit-2/ Aquaculture and Sericulture / 6 Hours Per Week |
| | 3 | Unit-3/ Structure of silk gland and secretion of silk / 7 Hours Per Week |
| | 4 | Unit-4/ Apiculture and Vermiculture / 7 Hours Per Week |
| | 5 | Unit-5/ Introduction of Vermiculture and Vermicomposting. /6 Hours Per Week |
| | | |
| | Detailed Syllabus | |
| | Module-1 | Aquaculture and Sericulture: Types of Fisheries; Fresh Water Fish and Prawn culture<br>Fresh water fishing gears and crafts; Induced Breeding, Hatchery design and Management of fish and prawn; Transportation of fish and prawn seed.<br>Preservation, Processing and By-products of fishes, Fish Diseases and control measures<br>Life cycle of Bombyx mori |
| | Module-2 | Structure of silk gland and secretion of silk, Silkworm rearing technology., Spinning, harvesting and storage of cocoons, Silk worm Pests and Diseases: Uzi fly; Protozoan, Viral, Fungal and Bacterial; Control and prevention, Prospects of Sericulture in India |
| | Module-3 | Apiculture and Vermiculture: Selection of Bee Species for Apiculture., Bee Keeping Equipment, Methods of Extraction of Honey (Indigenous and Modern)., Bee Diseases and Enemies, Products of Apiculture Industry and its Uses (Honey, Bees Wax) |
| | Module-4 | Introduction of Vermiculture and Vermicomposting: Vermiculture techniques, Bedding, Essential parameters for Vermiculture and Management, Methods of Harvesting (Manual & Mechanical), Economic Importance of Vermiculture. |
| | Module-5 | Poultry Farming & Animal Husbandry: Classification of Fowls based on their use – Broilers and Commercial layers, Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs.<br>Poultry diseases - Viral, Bacterial, Fungal, Protozoan<br>Management of a modern Poultry Farm, progressive plans to promote Poultry as a Self-Employment venture, Dairy farm and its management<br>Animal Husbandry – Introduction, Preservation of semen, artificial insemination of cattle, Induction of early puberty and synchronization of estrus in cattle |
| | **Recommended Books** | |
| | 1 | Animal Ecology" by M. Begon |
| | 2 | "Biotechnology" by J. E. Smith |
| | 3 | "Animal Biotechnology" by D. M. Glover |

# UNIVERSITY OF TECHNOLOGY, JAIPUR

**Syllabus**
**3rd Year B.Sc. (CBZ) - July-2022)**

## Chemistry Lab [BCBZ 352]

**Credit 1** **Max. Marks: 100 (IA:60, ETE:40)**
**0L+0T+2P**

**Inorganic Chemistry**

1. Synthesis & Analysis of
   (a) Potassium Trioxalatoferate (III), $K_3[Fe(C_2O_4)_3]$
   (b) Sulphate $[Cu(NH_3)_4]SO_4$
2. Instrumentation
   Calorimeter
   (a) Job's
   (b) Mole ratio's Method
   Adulteration Food Stuff
   Effluent water analysis
3. Solvent Extraction
   Separation & Extraction of Mg (II) & Fe (II)
   Ion Exchange Method
   Separation & Extraction of Mg (II) & Fe (II)

**Organic Chemistry**

1. Steam Distillation- naphthalene from its suspension of water
2. Clove oil from clove
3. Separation of o & p nitro phenol
4. Resolution of racemic mixture of (+) mendelic acid

**Physical Chemistry**

1. To determine the ionization constant of weak acid coductometrically
2. To study the saponification of ethyl acetate coductometrically
3. To study the strength of the give acid coductometrically using standard alkali solution

# UNIVERSITY OF TECHNOLOGY, JAIPUR

**Syllabus**
**3rd Year B.Sc. (CBZ) - July-2022)**

## Botany Lab [BCBZ 353]

**Credit 1** **Max. Marks: 100 (IA:60, ETE:40)**
**0L+0T+2P**

| |
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| **Plant Identification** |
| - Morphology and anatomy of flowering plants |
| - Identification of local flora |
| - Study of plant families (Fabaceae, Solanaceae, etc.) |
| |
| **Microscopy and Histology** |
| - Microscopy techniques |
| - Plant tissue preparation and staining |
| - Histology of plant tissues (root, stem, leaf) |
| |
| **Plant Tissue Culture and Propagation** |
| - Techniques of plant tissue culture |
| - Propagation of plants using seeds and vegetative methods |
| - Study of plant growth regulators |
| |
| **Cytology and Genetics** |
| -Chromosome preparation and analysis |
| - Genetic experiments (Monohybrid, Dihybrid, etc.) |
| - Study of genetic mutations |

# UNIVERSITY OF TECHNOLOGY, JAIPUR

**Syllabus**
**3rd Year B.Sc. (CBZ) - July-2022)**

## Zoology Lab [BCBZ 354]

**Credit 1** **Max. Marks: 100 (IA:60, ETE:40)**
**0L+0T+2P**

| |
|---|
| 1. Plant Identification |
| - Morphology and anatomy of flowering plants |
| - Identification of local flora |
| 2. Microscopy and Histology |
| - Microscopy techniques |
| - Plant tissue preparation and staining |
| - Histology of plant tissues |
| 3. Plant Tissue Culture and Propagation |
| - Techniques of plant tissue culture |
| - Propagation of plants using seeds and vegetative methods |
| 4. Cytology and Genetics |
| - Chromosome preparation and analysis |
| - Genetic experiments |