<u>**First Year – Second Semester**</u>
<u>**Engineering Mathematics II (BSC-121)**</u>
<u>**Basic Science Core (BSC); 4 Credits (3-1-0)**</u>

**Objectives:**

1. To provide knowledge of basic differential calculus and iterative integral and applications of integral in finding the arc length, surface area and volume etc.

| Unit | Contents | No. of Lectures |
|------|----------|-----------------|
| **Unit 1** | Multivariable Calculus (Integration): () Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes. | **08** |
| **Unit 2** | First order ordinary differential equations:Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. | **07** |
| **Unit 3** | : Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties. | **11** |
| **Unit 4** | Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.. | **07** |
| **Unit 5** | Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite | **13** |

| | integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.. | |
|---|---|---|
| | | **46** |

**Reference/Text Book:**

1. Advanced Engineering Mathematic By D. G. Zill and W. S. Wright.
2. Mathematical Analysis.By S.C. Malik and SavitaArora.
3. Higher Engineering mathematics By B.S. Grewal.
4. Calculus and Analytic Geometry By George B. Thomas, Jr. Ross L. Finney

## Chemistry (BSC-122)
## Basic Science Core (BSC); 5 Credits (3-1-2)

**Objectives:**

1. The Subject will provide information on structure of atoms, chemical bonds, chemical thermodynamics, chemical kinetics, polymer and electrochemistry.

| Unit | Contents | No. of Lectures |
|---|---|---|
| Unit 1 | Atomic and molecular structure :Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures. | 08 |
| Unit 2 | Spectroscopic techniques and applications:Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering. | 06 |
| Unit 3 | Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces. | 12 |
| Unit 4 | Use of free energy in chemical equilibria :Thermodynamic functions: energy, entropy | 12 |

| | | |
|---|---|---|
| | and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams. | |
| **Unit 5** | Periodic properties Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries<br>Stereochemistry Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds (vii) Organic reactions and synthesis of a drug molecule Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule. | 10 |
| | | 48 |

## Reference/Texts Books:

1. A New Concise Inorganic Chemistry", J. D. Lee, 5th Edition (1996), Chapman & Hall, London.

2. Principles of Physical Chemistry", B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), ShobanLalNagin Chand & Co., Jalandhar.

3. "Organic Chemistry", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.

4. Physical Chemistry, A Molecular Approach, Donald A. Mcquarrie, John D. Simon

5. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science.

6. Physical Chemistry, P. W Atkins

7. Physical Chemistry, Samuel Glasstone, McMillan India Ltd.

## List of Experiments

Chemistry is an experimental science – the concepts and models are based on experiment. Thus, the laboratories are designed to give students a "hands-on" experience in order to reinforce concepts. Students may encounter material in the laboratory before you see the material in lecture.

Choice of 10-12 experiments from the following:
1. Determination of surface tension and viscosity
2. Thin layer chromatography

3. Ion exchange column for removal of hardness of water

4. Determination of chloride content of waterColligative properties using freezing point depression

5. Determination of the rate constant of a reaction

6. Determination of cell constant and conductance of solutions

7. Potentiometry - determination of redox potentials and emfs

8. Synthesis of a polymer/drug

9. Saponification/acid value of an oil

10. Chemical analysis of a salt  Lattice structures and packing of spheres

11. Models of potential energy surfaces

12. Chemical oscillations- Iodine clock reaction

13. Determination of the partition coefficient of a substance between two immiscible liquids  Adsorption of acetic acid by charcoal

### Basic Electrical and Electronics Engineering (ESC-121)
### Engineering Science Courses (ESC); 5 Credits (3-1-2)

**Objectives:**

1. Basic idea of the Subject will be to introduce the basic concepts required to understand the electronic devices, circuits and measuring instruments.

| Unit | Contents | No. of Lectures |
|------|----------|-----------------|
| Unit 1 | Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits. | 08 |
| Unit 2 | Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections | 10 |
| Unit 3 | Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. | 10 |
| Unit 4 | Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss | 12 |

| | | |
|---|---|---|
| | components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.. | |
| **Unit 5** | Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup. | **08** |
| | | **48** |

**Reference/Text Book:**

1) Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition 2010, Tata McGraw Hill.

2) Basic Electrical Engineering - D.C. Kulshreshtha, 2009, Tata McGraw Hill.

3) Fundamentals of Electrical Engineering, L.S. Bobrow, Oxford University Press, 2011

4) Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson, 2010

5) Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice Hall India, 1989

## Workshop Practices (ESC-122)
### Engineering Sciences Courses (ESC); 2 Credits (0-0-4)

**Objectives:**

1. Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops. This course intends to impart basic know-how of various hand tools and their use in different sections of manufacturing. Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems.

2. The workshop experiences would help to build the understanding of the complexity of the industrial job, along with time and skills requirements of the job. Workshop curricula build the hands on experiences which would help to learn manufacturing processes and production

technology courses in successive semesters. Workshop practice is also important since only practice can make the man perfect.

3. The students are advised to undergo each skill experience with remembrance, understanding and application with special emphasis on attitude of enquiry to know why and how for the various instructions and practices imparted to them in each shop.

| Unit | Contents | No. of Lectures |
|---|---|---|
| **Unit 1** | **Introduction to Workshop:** Workshop layout, Importance of various sections/shops of workshop, Types of jobs done in each shop, General safety rules and work procedure in workshop. | **04** |
| **Unit 2** | **Fitting:** Sketch, specification and applications of fitting work holding tools-bench vise, V-block with clamp and C-clamp, Sketch, specification , material ,applications and methods of using fitting marking and measuring tools-marking table, surface plate, angle plate, universal scribing block, try-square, scriber, divider, centre punch, letter punch, calipers, vernier caliper, etc. Types, sketch, specification , material , applications and methods of using of fitting cutting toolshacksaw, chisels, twist drill, taps, files, dies, Types, sketch, specification, material, applications and methods of using of fitting finishing tools-files, reamers. Sketch, specification and applications of miscellaneous tools-hammer, spanners, screw drivers sliding screw wrench, Demonstration of various fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping, Preparation of simple and male- female joints, Safety precautions. | **12** |
| **Unit 3** | **Tin Smithy:** Concept and conversions of SWG and other gauges in use, Use of wire gauge, Types of sheet metal joints and applications, Types, sketch, specification, material, applications and methods of using tin smithy tools-hammers, stakes, scissors/snips, etc. Demonstration of various tin smithy tools and sheet metal operations such as shearing, bending and joining, Preparation of tin smithy job, Safety precautions. | **12** |
| **Unit 4** | **Carpentry:** Types, sketch, specification, material, applications and methods of using of carpentry tools-saws, planner, chisels, hammers, pallet, marking gauge, vice, try square, rule, etc. Types of woods and their applications, Types of carpentry hardwares and their uses, Demonstration of carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, etc. Preparation of wooden joints, Safety | **07** |

| | | |
|---|---|---|
| | precautions. | |
| Unit 5 | **Mattel Joining:** Types, specification, material and applications of arc welding transformers, Types, specification, material and applications of arc welding accessories and consumables, Demonstration of metal joining operations- arc welding, soldering and brazing. Show effect of current and speed. Also demonstrate various welding positions, Demonstrate gas cutting operation, Preparation of metal joints, Safety precautions.,welding,glass cutting<br>Electrical & electronics(1 lecture) | 07 |
| | | 42 |

**Reference/Text Books:**

1. K.C. John. Mechanical workshop practice. PHI.
2. S.K. Garg. Comprehensive Workshop Technology (Manufacturing Processes). Laxmi publications.
3. I.T.B. Handbook. Engineering industry Training Board.
4. K.Venkata Reddy. Workshop practice manual. B.S.Publications.