# SEMESTER II COURSE CONTENTS

| Course Code | BSC 104 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| Course Title | **Mathematics – II**<br><br>**Contents**<br>**Calculus, Ordinary Differential Equations and Complex Variable (Option 1) for All branches excluding CSE**<br>**Probability and Statistics (Option I1) for CSE** | | | | |
| Scheme & Credits | L | T | P | Credit | Semester |
| | 3 | 1 | 0 | 0 | II |
| Pre-requisites | Elementary Knowledge of calculus, Probability and Statistics | | | | |

# MATHEMATICS - II

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CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE (OPTION 1)   for All branches excluding CSE                        40 Lectures
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**Module 1**: **Multivariable Calculus (Integration):**                **10 Lectures**
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.

**Module 2: First order ordinary differential equations:**                **06 Lectures**
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.

**Module 3: Ordinary differential equations of higher orders:**                **08 Lectures**
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.

**Module 4: Complex Variable - Differentiation:**                **08 Lectures**
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.

**Module 5: Complex Variable - Integration:**                                    **08 Lectures**

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

**Textbooks/References:**
- G.B. Thomas & R.L. Finney, Calculus & Analytic geometry, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
- S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
- E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 1995.
- E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
- J. W. Brown & R. V. Churchill, Complex Variables & Appln, Mc-Graw Hill, 2004.
- N.P. Bali and Manish Goyal, Engineering Mathematics, Laxmi Pub, Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

**COURSE OUTCOME**

**T**o familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.

To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

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**PROBABILITY AND STATISTICS        (OPTION 2)  FOR CSE ONLY        40 Lectures**

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**Module 1: Basic Probability:**                                    **12 Lectures**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

**Module 2: Continuous Probability Distributions:**                    **04 Lectures**
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

**Module 3: Bivariate Distributions:**                    **04 Lectures**
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

**Module 4: Basic Statistics:**                    **08 Lectures**
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation

**Module 5: Applied Statistics:**                    **08 Lectures**
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

**Module 6: Small samples:**                    **04 Lectures**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

**Textbooks/References:**
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
- S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
- W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
- Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

**COURSE OUTCOME**
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To introduce effective mathematical tools for the solutions of differential equations that model physical processes.
- To introduce the tools of differentiation and integration of functions of complex variable that is used in various techniques dealing engineering problems.

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| Course Code | BSC 105 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| Course Title | Course contents in Physics<br><br>(i) Introduction to Quantum Mechanics for Engineers –  For EEE, CSE<br>(ii) Semiconductor Optoelectronics –  For ECE<br>(iii) Mechanics of Solid – For Civil, ME, MEMS<br>(iv) Optics & Fiber Optics –  For Chemical Engineering | | | | |
| Scheme & Credits | L | T | P | Credit | Semester II |
| | 2 | 1 | 0 | 3 | |
| Pre-requisites | Mathematics course on differential equations and linear algebra<br>Introduction to Electromagnetic Theory<br>Semiconductor Physics | | | | |

# Physics-II

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**INTRODUCTION TO QUANTUM MECHANICS FOR ENGINEERS          For EEE, CSE**
**38 Lectures**

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**Module 1: Wave nature of particles and the Schrodinger equation          8 Lectures**
Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle

**Module 2: Mathematical Preliminaries for quantum mechanics          5 Lectures**
Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators.

**Module 3: Applying the Schrodinger equation          7 Lectures**
Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, square-well potential, linear harmonic oscillator.

**Module 4: Bound Quantum States**                                              **10 Lectures**

Numerical solution of stationary-state Schrodinger equation for one dimensional problems for different potentials Scattering from a potential barrier and tunneling. Three-dimensional problems: particle in three dimensional box, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbitals, interaction with magnetic field.

**Module 5: Introduction to solids**                                           **8 Lectures**

Free electron theory of metals, Fermi level, density of states, Application to white dwarfs and neutron stars, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

**Text book:**
- Eisberg and Resnick, Introduction to Quantum Physics Publisher New York: Wiley. Collection printdisabled

**Reference Books:**
- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

**COURSE OUTCOMES**

Students to learn the basics of Quantum mechanics and its application to bound states.

To understand the wave particle duality.

To familiarize with the molecular bonding, free electron theory and periodic potentials in solids.

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**SEMICONDUCTOR OPTOELECTRONICS**                                                      **For ECE**
                                                                                        **36 Lectures**

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**Module 1: Review of semiconductor physics**                                          **10 Lectures**
E-k diagram, Density of states, Occupation probability, Fermi level; p-n junction, Metal-semiconductor junction (Ohmic and Schottky); Carrier transport, generation, and recombination; Semiconductor materials of interest for optoelectronic devices, band gap modification, hetero structures; Light semiconductor interaction: Rates of optical transitions, joint density of states, condition for optical amplification.

**Module 2: Semiconductor light emitting diodes (LEDs)**                                **06 Lectures**
Rate equations for carrier density, Radiative and non-radiative recombination mechanisms in semiconductors, LED: device structure, materials, characteristics, and figures of merit.

**Module 3: Semiconductor lasers**                                                      **08 Lectures**
Rate equations for carrier- and photon-density, and their steady state solutions, Laser dynamics, Relaxation oscillations, Input-output characteristics of lasers. Semiconductor laser: structure, materials, device characteristics, and figures of merit.

**Module 4: Photo-detectors**                                                           **06 Lectures**
Types of semiconductor photodetectors -p-n junction, PIN, and Avalanche -- and their structure, materials, working principle, and characteristics, Solar cells.

**Module 5**: **Low-dimensional optoelectronic devices**                                **06 Lectures**
Quantum-well, -wire, and -dot based LEDs, lasers, and photo-detectors.


**References:**
- J. Singh, Semiconductor Optoelectronics: Physics and Tech., McGraw-Hill Inc. (1995).
- B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons,
- S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
- Yariv and P. Yeh, Photonics: Optical Electronics in Mod. Comm, OUP, NY (2007).
- P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
- Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL
- Online course: "Optoelectronic Materials & Devices" by Monica Katiyar & Deepak Gupta on NPTEL

**COURSE OUTCOME**
Students to review the concepts of semiconductor physics.
To learn about the semiconductor LEDs and semiconductor Lasers.
To have the understanding of photo detectors and low dimensional optoelectronic devices.

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**MECHANICS OF SOLIDS**                                              **For Civil, ME, MEMS**
                                                                    **40 Lectures**

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**Module 1: Statics**                                                           **10 Lectures**
Free body diagrams on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations.


**Module 2: Stress and Strain at a point**                                         **6 Lectures**
Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stresses and Mohr's circle; Displacement *field; Concept of strain at a point; Planet strain:* transformation of strain at a point, principal strains and Mohr's circle.


**Module 3: Material behavior**                                                    **7 Lectures**
One- dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials.


**Module 4: Force analysis**                                                       **8 Lectures**
Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions);; Moment curvature relationship for pure bending of beams with symmetric cross-section; Bending stress; Shear stress; Cases of combined stresses;


**Module 5: Strain energy**                                                        **9 Lectures**
Concept of strain energy; Yield criteria; De*flection due to bending; Integration of* the moment-curvature relationship for simple boundary conditions; Method of superposition (without using singularity functions); Strain energy and complementary strain energy for simple structural elements (i.e. those under axial load, shear force, bending moment and torsion).


**Reference books:**
- An Introduction to the Mechanics of Solids, 2nd ed. with SI Units - SH Crandall, NC
- Dahl & TJ Lardner

- Engineering Mechanics: Statics, 7th ed. — JL Meriam
- Engineering Mechanics of Solids — EP Popov

## COURSE OUTCOME

To familiarize students of civil and mechanical engineering with the understanding of the elastic and plastic behavior of solids.

To understand the importance of stress and strain at a point on solid.

To be able to do force analysis and understand strain energy of solid.

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**OPTICS AND FIBER OPTICS**                                    **For Chemical Engineering**
                                                                                            **36 Lectures**

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**Module 1: Interference**                                                      **07 Lectures**

Introduction to interference and example, Theory of fringes, Analytical treatment of interference, Displacement of fringes, Thin film, Newton's Ring, Wedge shaped film.

**Module 2: Diffraction**                                                       **06 Lectures**

concept of diffraction, Fraunhoffer and Fresnel diffraction, Fraunhoffer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications, Limit of Resolution,  Resolving power of grating.

**Module 3: Polarisation**                                                      **06 Lectures**

Introduction, plane of polarization, plane of vibration, polarisation by reflection: Brewester's Law, polarisation by refraction: Malus' Law, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.

**Module 4: Fibre Optics**                                                      **07 Lectures**

Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres.

**Module 5**: **Lasers**                                                                                    **10 Lectures**
Introduction to interaction of radiation with matter, Stimulated and spontaneous emission, Einstein's coefficient, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, three level and four level laser, types of laser: solid state, semiconductor, gas; application of lasers.

**Reference Books**
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

**COURSE OUTCOMES**
To understand the optical phenomenon of interference, diffraction and polarization,
To get familiarize with fiber optics and laser, their basic concept and application in engineering**.**
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| Course Code | BSC 102 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| Course Title | **Chemistry-I**<br>**Contents**<br>(i) Chemistry-I (Concepts in chemistry for engineering)<br>(ii) Chemistry Laboratory | | | | |
| Scheme & Credits | L | T | P | Credit | Semester I |
| | 3 | 1 | 0 | 4 | |
| Pre-requisites | Knowledge of intermediate level chemistry | | | | |

## CHEMISTRY-I

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# CONCEPTS IN CHEMISTRY FOR ENGINEERING          42 Lectures

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**Module 1: Atomic and molecular structure**                          **12 lectures**
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.

**Module 2: Spectroscopic techniques and applications**                      **8 lectures**
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.

**Module 3: Intermolecular forces and potential energy surfaces**         **4 lectures**
Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of $H_3$, $H_2F$ and HCN and trajectories on these surfaces.

**Module 4: Use of free energy in chemical equilibria**                      **6 lectures**
Thermodynamic functions: energy, entropy 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. Waterchemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

**Module 5: Periodic properties and Stereochemistry**                    **8 Lectures**

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

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

**Module 6: Organic reactions and synthesis of a drug molecule**                    **4 lectures**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

**Books:**
- University chemistry, by B. H. Mahan
- Chemistry: Principles and Applications, by  M. J. Sienko and R. A. Plane
- Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- Engg Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- Physical Chemistry, by P. W. Atkins
- Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

**COURSE OUTCOMES**

The concepts developed in this course will aid in quantification of several concepts in chemistry hat have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

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**CHEMISTRY LABORATORY**                                                      **Code: BSC 102P**

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**Choice of 08-10 experiments from the following:**
- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary visco meters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

**LABORATORY OUTCOMES**
- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

| Course Code | ESC 103 | | | | |
|---|---|---|---|---|---|
| Category | Engineering Science Course | | | | |
| Course Title | Programming for Problem Solving | | | | |
| Scheme & Credits | L | T | P | Credit | Semester II |
| | 3 | 0 | 0 | 3 | |
| Pre-requisites | Basic Knowledge of Computer and Mathematics | | | | |

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# PROGRAMMING FOR PROBLEM SOLVING          40 Lectures

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### Module 1: Introduction to Programming                           6 lectures
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

### Module 2: Arithmetic expressions and precedence                12 lectures
Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching, Iteration and loops

### Module 3: Arrays                                                3 Lectures
 Arrays (1-D, 2-D), Character arrays and Strings

### Module 4: Basic Algorithms, Searching, Basic Sorting Algorithms     4 lectures
(Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

### Module 5:  Function and Pointers                                6 lectures
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).

**Module 6:  Recursion and Structure**                                                **9 lectures**
Recursion, as a different way of solving problems. Example programs, such as Finding, Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.
Structures, Defining structures and Array of Structures

**Suggested Text Books**
- Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

**Suggested Reference Books**
- Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

**COURSE OUTCOMES**
The student will learn
To formulate simple algorithms for arithmetic and logical problems.
To translate the algorithms to programs (in C language).
To test and execute the programs and correct syntax and logical errors.
To implement conditional branching, iteration and recursion.
To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
To use arrays, pointers and structures to formulate algorithms and programs.
To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.
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**LABORATORY - PROGRAMMING FOR PROBLEM SOLVING          Code: ESC103P**

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**[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]**

**Tutorial 1:**     Problem solving using computers:
**Lab1:**          Familiarization with programming environment


**Tutorial 2:**     Variable types and type conversions:
**Lab 2:**          Simple computational problems using arithmetic expressions


**Tutorial 3:**     Branching and logical expressions:
**Lab 3**:          Problems involving if-then-else structures


**Tutorial 4:**      Loops, while and for loops:
**Lab 4:**          Iterative problems e.g., sum of series


**Tutorial 5:**     1D Arrays: searching, sorting:
**Lab 5:**          1D Array manipulation


**Tutorial 6:**     2D arrays and Strings
**Lab 6:**          Matrix problems, String operations


**Tutorial 7:**     Functions, call by value:
**Lab 7:**          Simple functions


**Tutorial 8 & 9:** Numerical methods (Root finding, numerical differentiation, numerical integration):
**Lab 8 and 9:** Programming for solving Numerical methods problems


**Tutorial 10:**     Recursion, structure of recursive calls
**Lab 10:**          Recursive functions


**Tutorial 11:**     Pointers, structures and dynamic memory allocation
**Lab 11:**          Pointers and structures


**Tutorial 12:**     File handling:
**Lab 12:**          File operations

**LABORATORY OUTCOMES**

 To formulate the algorithms for simple problems.

To translate given algorithms to a working and correct program.

To be able to correct syntax errors as reported by the compilers.

To be able to identify and correct logical errors encountered at run time.

To be able to write iterative as well as recursive programs.

To be able to represent data in arrays, strings and structures and manipulate them through a program.

To be able to declare pointers of different types and use them in defining self referential structures.

To be able to create, read and write to and from simple text files.

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| Course Code | ESC 104 | | | | |
|---|---|---|---|---|---|
| Category | Engineering Science Course | | | | |
| Course Title | **Workshop/Manufacturing Practices**<br>(Theory & Lab) | | | | |
| Scheme & Credits | L | T | P | Credit | Semester II |
| | 1 | 0 | 4 | 3 | |
| Pre-requisites | Basic Knowledge of Physics, Chemistry and Mathematics | | | | |

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# WORKSHOP/MANUFACTURING PRACTICES          10 Lectures

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1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Electrical & Electronics **(1 lecture)**
5. Carpentry **(1 lecture)**
6. Plastic Moulding, glass cutting **(1 lecture)**
7. Metal casting **(1 lecture)**
8. Welding (arc welding & gas welding), brazing **(1 lecture)**

**Suggested Text/Reference Books:**
- Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
- Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan & A. Suresh Babu, "Mfg. Tech- I" Pearson Education, 2008.
- Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, PHl, 1998.
- Rao P.N., "Manufacturing Technology", Vol. I & Vol. II, Tata McGrawHill House, 2017.

**COURSE OUTCOMES**
Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

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**WORKSHOP PRACTICE**                                      **60 Lectures**

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1. Machine shop                                     **(10 hours)**

2. Fitting shop                                      **(8 hours)**

3. Carpentry                                      **(6 hours)**

4. Electrical & Electronics                        **(8 hours)**

5. Welding shop            **(8 hours (Arc welding 4 hrs + gas welding 4 hrs))**

6. Casting                                     **(8 hours)**

7. Smithy                                      **(6 hours)**

8. Plastic Moulding &                          **(6 hours**)

Glass Cutting

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

**LABORATORY OUTCOMES**
- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

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| Course Code | HSMC 101 | | | | |
|---|---|---|---|---|---|
| Category | Humanities and Social Sciences including Management Courses | | | | |
| Course Title | English | | | | |
| Scheme & Credits | L | T | P | Credit | Semester II |
| | 2 | 0 | 2 | 3 | |
| Pre-requisites | Basic Knowledge of English grammar and composition | | | | |

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# ENGLISH                                                                    38 Lectures

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**Module 1: Vocabulary Building**                                          **6 lecture**
The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms and standard abbreviations.

**Module 2: Basic Writing Skills**                                         **6 lectures**
Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

**Module 3:  Identifying Common Errors in Writing**                        **7 lectures**
Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

**Module 4: Nature and Style of sensible Writing**                         **6 lectures**
Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

**Module 5: Writing Practices**                                            **6 lectures**
Comprehension, Précis Writing, Essay Writing,

**Module 6: Oral Communication**                                           **7 lectures**
(This unit involves interactive practice sessions in Language Lab)
Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday, Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.

**Suggested Readings:**
- Practical English Usage. Michael Swan. OUP. 1995.
- Remedial English Grammar. F.T. Wood. Macmillan.2007
- On Writing Well. William Zinsser. Harper Resource Book. 2001
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

**COURSE OUTCOMES**

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

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# *A Guide to Induction Program*

**Mandatory Induction Program**

| 3 weeks duration |
| --- |
| • Physical activity |
| • Creative Arts |
| • Universal Human Values |
| • Literary |
| • Proficiency Modules |
| • Lectures by Eminent People |
| • Visits to local Areas |
| • Familiarization to Dept./Branch & Innovations |

## 1 Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017.It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016. This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help institutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond.

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer environment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them  work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

# 2 Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

## 2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

## 2.2 Creative Arts

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

**2.3 Universal Human Values**

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT (BHU) are noteworthy and one can learn from them.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

**2.4 Literary**

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

**2.5 Proficiency Modules**

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

**2.6 Lectures by Eminent People**

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

**2.7 Visits to Local Area**

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

**2.8 Familiarization to Dept./Branch & Innovations**

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

# 3 Schedules

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

**3.1 Initial Phase**

| Time | Activity |
|---|---|
| **Day 0** | |
| Whole day | Students arrive - Hostel allotment. (Preferably do pre-allotment) |
| **Day 1** | |
| 09:00 am - 03:00 pm | Academic registration |
| 04:30 pm - 06:00 pm | Orientation |
| **Day 2** | |
| 09:00 am - 10:00 am | Diagnostic test (for English etc.) |
| 10:15 am - 12:25 pm | Visit to respective depts. |
| 12:30 pm - 01:55 pm | Lunch |
| 02:00 pm - 02:55 pm | Director's address |
| 03:00 pm - 05:00 pm | Interaction with parents |
| 03:30 pm - 05:00 pm | Mentor-mentee groups - Introduction within group. (Same as Universal Human Values groups) |

**3.2 Regular Phase**
After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

**3.2.1 Daily Schedule**

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

| Sessn. | Time | Activity | Remarks |
|---|---|---|---|
| | **Day 3 onwards** | | |
| | 06:00 am | Wake up call | |
| I | 06:30 am - 07:10 am | Physical activity (mild exercise/yoga) | |
| | 07:15 am - 08:55 am | Bath, Breakfast, etc. | |
| II | 09:00 am - 10:55 am | Creative Arts / Universal Human Values | Half the groups do Creative Arts |
| III | 11:00 am - 12:55 pm | Universal Human Values / Creative Arts | Complementary alternate |
| | 01:00 pm - 02:25 pm | Lunch | |
| IV | 02:30 pm - 03:55 pm | Afternoon Session | See below. |
| V | 04:00 pm - 05:00 pm | Afternoon Session | See below. |
| | 05:00 pm - 05:25 pm | Break / light tea | |
| VI | 05:30 pm - 06:45 pm | Games / Special Lectures | |
| | 06:50 pm - 08:25 pm | Rest and Dinner | |
| VII | 08:30 pm - 09:25 pm | Informal interactions (in hostels) | |

Sundays are off. Saturdays have the same schedule as above or have outings.

**3.2.2 Afternoon Activities (Non-Daily)**

The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone:
1. Familiarization to Dept./Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules
Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

| Activity | Session | Remarks |
|---|---|---|
| Familiarization with Dept/Branch & Innovations | IV | For 3 days (Day 3 to 5) |
| Visits to Local Area | IV, V and VI | For 3 days - interspersed (e.g., 3 Saturdays) |
| Lectures by Eminent People | IV | As scheduled - 3-5 lectures |
| Literary (Play / Book Reading / Lecture) | IV | For 3-5 days |
| Proficiency Modules | V | Daily, but only for those who need it |

**3.3 Closing Phase**

| Time | Activity |
|------|----------|
| **Last But One Day** | |
| 08:30 am - 12 noon | Discussions and finalization of presentation within each group |
| 02:00 am - 05:00 pm | Presentation by each group in front of 4 other groups besides their own (about 100 students) |
| **Last Day** | |
| Whole day | Examinations (if any). May be expanded to last 2 days, in case needed. |

**3.4 Follow Up after Closure**

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a *student guide*, and for every 20 students, there would be a *faculty mentor*.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline. Here we list some important suggestions which have come up and which have been experimented with.

**3.4.1 Follow Up after Closure – Same Semester**

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

**3.4.2 Follow Up – Subsequent Semesters**

It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (up to fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

## 4 Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution. The graduating student must have values as a human being, and knowledge and met skills related to his/her profession as an engineer and as a citizen. Most students, who get demotivated to study engineering or their branch, also lose interest in learning. The *Induction Program* is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character. The *Universal Human Values* component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.