# MODEL CURRICULUM

For

# FIRST YEAR UNDERGRADUATE DEGREE COURSES IN ENGINEERING & TECHNOLOGY [November 2017]

**All India Council for Technical Education**
**Nelson Mandela Marg, Vasant Kunj, New Delhi 110 070**
**www.aicte-india.org**

## FOREWORD

The Ministry of Human Resource Development(MHRD), Government of India and All India Council for Technical Education(AICTE) are working on a mission mode to improve the quality of engineering education in the country. All India Council for Technical Education (AICTE) in its 49th meeting of the Council held on 14th March, 2017 approved a package of measures for improving the quality of technical education in the country amongst which mandatory internship, faculty induction training program, student induction and revision of curriculum are some of them. In engineering education, IITs have already set up a sterling example, therefore, it was of utmost importance that a revised AICTE model curriculum be prepared keeping in view the latest industry trends and market requirement in all major engineering subjects and be made available to all universities and engineering institutions in the country. With the support of Ministry of Human Resource Development, AICTE constituted subject-wise heads of the committees from IITs with respective team of 2-3 academic experts along with industry expert to revise the model curriculum of undergraduate engineering courses.

In this endeavor, a 3 week long mandatory induction program for students was also designed to be offered right at the start of the first year as a major initiative by AICTE; it was developed by a separate committee from IIT-BHU. Through this program, 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. AICTE conducted one-day workshops for heads of institutions at various cities in India during the recent months to create awareness about the student induction program. Thereafter 5 days "Teacher Training Workshops" on induction program were also held in various parts of the country to orient and train the faculty to impart induction training to students. The Executive Committee of AICTE in its meetings approved the revision of model curriculum structure of engineering courses and subsequently approved the model curriculum of first two semesters to be communicated to all universities and engineering institutions. Subsequently, detailed curricula for remaining semesters was also prepared by the committees.

It is with great pleasure and sincere thanks to each of the *Head of the Committee* along with their *team of experts* who have developed and revised the model curriculum for major engineering disciplines by framing the Scheme of Instructions and Syllabi keeping in view the latest industry requirements to enhance employability and produce well rounded engineers for the benefit of industry, society and the nation. AICTE is immensely thankful to *Prof. Rajeev Sangal, Director[IIT(BHU] and his team* for developing the mandatory induction program for students. The institutions/ universities in India are requested to adopt this "Model Curriculum" for various engineering disciplines.

AICTE shall upload the curriculum (scheme of instructions and detailed syllabi) of all engineering disciplines to be adopted by institutions and universities and hope that all concerned are benefitted to maintain uniform standards of technical education throughout the country.

AICTE thanks MHRD for providing guidance and support during the revision of this model curriculum.

***(Prof. Anil D. Sahasrabudhe)***
***Chairman, AICTE***

Date : 13 November, 2017
Place : New Delhi

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# Model Curriculum for
# First Year
# Undergraduate Degree Courses in Engineering & Technology

## Chapter -1
### General, Course structure & Theme
### &
### Semester-wise credit distribution

**A. Definition of Credit**:-

| | |
|---|---|
| 1 Hr. Lecture (L) per week | 1 credit |
| 1 Hr. Tutorial (T) per week | 1 credit |
| 1 Hr. Practical (P) per week<br><br>2 Hours Practical(Lab)/week | 0.5 credits<br><br>1 credit |

**B. Range of credits –**

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

**C. Structure of Undergraduate Engineering program:-**

| S. No. | Category | Suggested Breakup of Credits(Total 160) |
|---|---|---|
| 1 | Humanities and Social Sciences including Management courses | 12* |
| 2 | Basic Science courses | 25* |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc | 24* |
| 4 | Professional core courses | 48* |
| 5 | Professional Elective courses relevant to chosen specialization/branch | 18* |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | 18* |
| 7 | Project work, seminar and internship in industry or elsewhere | 15* |
| 8 | Mandatory Courses<br>[Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge] | (non-credit) |
| | Total | 160* |

**Minor variation is allowed as per need of the respective disciplines.*

## D. Credit distribution in the First year of Undergraduate Engineering program:

| | Lecture (L) | Tutorial (T) | Laboratory/Practical (P) | Total credits (C ) |
|---|---|---|---|---|
| Chemistry -I | 3 | 1 | 3 | 5.5 |
| Physics | 3 | 1 | 3 | 5.5 |
| Maths-1 | 3 | 1 | 0 | 4 |
| Maths -2 | 3 | 1 | 0 | 4 |
| Programming for Problem solving | 3 | 0 | 4 | 5 |
| English | 2 | 0 | 2 | 3 |
| Engineering Graphics & Design | 1 | 0 | 4 | 3 |
| Workshop/ Practicals | 1 | 0 | 4 | 3 |
| Basic Electrical Engg. | 3 | 1 | 2 | 5 |
| *Biology | 2 | 1 | 0 | 3 |
| *Engg. Mechanics | 3 | 1 | 0 | 4 |
| *Maths-3 | 3 | 1 | 0 | 4 |

**These courses may be offered preferably in the 3rd semester & onwards.*

## E. Course code and definition:-

| Course code | Definitions |
|---|---|
| L | Lecture |
| T | Tutorial |
| P | Practical |
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| HSMC | Humanities and Social Sciences including Management courses |
| PCC | Professional core courses |
| PEC | Professional Elective courses |
| OEC | Open Elective courses |
| LC | Laboratory course |
| MC | Mandatory courses |
| PROJ | Project |

## F. Category of Courses:-

### BASIC SCIENCE COURSES

| Sl. No. | Course Code | Course Title | Hours per week | | | Credits | Preferred semester |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 2 | BSC101 | Physics | 3 | 1 | 3 | 5.5 | I |
| 1 | BSC102 | Chemistry-I | 3 | 1 | 3 | 5.5 | II |
| 3 | BSC103 | Maths –I | 3 | 1 | 0 | 4 | I |
| 4 | BSC104 | Maths –2 | 3 | 1 | 0 | 4 | II |

## ENGINEERING SCIENCE COURSES

| Sl. No. | Course Code | Course Title | Hours per week | | | Credits | Preferred semester |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | ESC101 | Basic Electrical Engineering | 3 | 1 | 2 | 5 | I |
| 2 | ESC102 | Engineering Graphics & Design | 1 | 0 | 4 | 3 | I |
| 3 | ESC103 | Programming for Problem Solving | 3 | 0 | 4 | 5 | II |
| 4 | ESC104 | Workshop/Manufacturing Practices | 1 | 0 | 4 | 3 | II |
| | | | | | | | |

## HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

| Sl. No. | Course Code | Course Title | Hours per week | | | Credits | Preferred Semester |
|---|---|---|---|---|---|---|---|
| | | | L | T | P | | |
| 1 | HSMC101 | English | 2 | 0 | 2 | 3 | II |

### G. Structure of curriculum

**Mandatory Induction Program**

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

**Semester I (First year]**
**Branch/Course Common to all branches of UG Engineering & Technology**

| Sl. No. | Category | Course Code | Course Title | Hours per week | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | |
| 1 | Basic Science course | BSC101 | Physics | 3 | 1 | 3 | 5.5 |
| 2 | Basic Science course | BSC103 | Maths –I | 3 | 1 | 0 | 4 |
| 3 | Engineering Science Courses | ESC101 | Basic Electrical Engineering | 3 | 1 | 2 | 5 |
| 4 | Engineering Science Courses | ESC102 | Engineering Graphics & Design | 1 | 0 | 4 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| | **Total credits** | | | | **17.5** |

## Semester II (First year]
## Branch/Course : Common to all branches of UG Engineering & Technology

| Sl. No. | Category | Code | Course Title | Hours per week | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | |
| 1 | Basic Science courses | BSC 102 | Chemistry-I | 3 | 1 | 3 | 5.5 |
| 2 | Basic Science courses | BSC 104 | Maths –II | 3 | 1 | 0 | 4 |
| 3 | Engineering Science Courses | ESC103/2 | Programming for Problem Solving | 3 | 0 | 4 | 5 |
| 4 | Engineering Science Courses | ESC104 | Workshop/Manufacturing Practices | 1 | 0 | 4 | 3 |
| 5 | Humanities and Social Sciences including Management courses | HSMC101 | English | 2 | 0 | 2 | 3 |
| | | | **Total credits** | | | | **20.5** |

# Chapter -2
## Detailed first year curriculum contents

## i. Mandatory Induction program (Please refer Appendix A)

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

## ii. Undergraduate Degree courses

| | | | | | |
|---|---|---|---|---|---|
| **Course code** | BSC102 | | | | |
| Category | Basic Science Course | | | | |
| **Course title** | **Chemistry-I (Theory & Lab.)**<br>**Contents**<br>(i) Chemistry-I (Concepts in chemistry for engineering)<br>(ii) Chemistry Laboratory | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester –II |
| | **3** | **1** | **3** | **5.5** | |
| **Pre-requisites (if any)** | - | | | | |

## (i)Chemistry-I (Concepts in chemistry for engineering) [L : 3; T:1; P : 0 (4 credits)]

**Detailed contents**

***(i) 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.

***(ii) 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.

***(iii) 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.

***(iv) 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. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

***(v) Periodic properties (4 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

***(vi) Stereochemistry (4 lectures)***

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 (4 lectures)***

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

**Suggested Text Books**

(i) University chemistry, by B. H. Mahan
(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) 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 that 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.

**(ii)Chemistry Laboratory[ L : 0; T:0 ; P : 3 (1.5 credits)]**

**Choice of 10-12 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 viscosimeters 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** | BSC101 | | | | |
| Category | Basic Science Course | | | | |
| **Course title** | **Physics (Theory & Lab.)** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester-I |
| | **3** | **1** | **3** | **5.5** | |
| | **Course contents in Physics(Any one)**<br>(i) Introduction to Electromagnetic Theory<br>(ii) Introduction to Mechanics<br>(iii) Quantum Mechanics for Engineers<br>(iv) Oscillation, Waves and Optics | | | | |

## (i)Introduction to Electromagnetic Theory[L : 3; T:1; P : 0 (4 credits)]

| | |
|---|---|
| **Pre-requisites (if any)** | Mathematics course with vector calculus |

**Detailed contents:**

***Module 1: Electrostatics in vacuum (8 lectures)***

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

***Module 2: Electrostatics in a linear dielectric medium (4 lectures)***

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

***Module 3: Magnetostatics(6 lectures)***

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

***Module 4: Magnetostatics in a linear magnetic medium (3 lectures)***

Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$ ; Boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and feromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

***Module 5: Faraday's law (4 lectures)***

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of

Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

***Module 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations (5 lectures)***

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

***Module 7: Electromagnetic waves (8 lectures)***

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

**Suggested Text Books**

(i) David Griffiths, Introduction to Electrodynamics

**Suggested Reference Books:**

(i) Halliday and Resnick, Physics
(ii) W. Saslow, Electricity, magnetism and light

**Course Outcomes**

- To be uploaded

❖ **Laboratory - Introduction to Electromagnetic Theory[ L : 0; T:0 ; P : 3 (1.5 credits)]**

**Choice of experiments from the following:**

- Experiments on electromagnetic induction and electromagnetic breaking;
- LC circuit and LCR circuit;
- Resonance phenomena in LCR circuits;
- Magnetic field from Helmholtz coil;
- Measurement of Lorentz force in a vacuum tube.

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## (ii)Introduction to Mechanics[L : 3; T:1; P : 0 (4 credits)]

| | |
|---|---|
| **Pre-requisites (if any)** | High-school education |

**Detailed contents:**

***Module 1: (8 lectures)***

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

***Module 2: (7 lectures)***

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;

***Module 3: (5 lectures)***

Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula.
Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;

***Module 4: (6 lectures)***

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

***Module 5: (5 lectures)***

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

***Module 6: (7 lectures)***

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

**Suggested Reference Books**

(i) Engineering Mechanics, 2nd ed. — MK Harbola
(ii) Introduction to Mechanics — MK Verma

(iii) An Introduction to Mechanics — D Kleppner & R Kolenkow
(iv) Principles of Mechanics — JL Synge & BA Griffiths
(v)Mechanics — JP Den Hartog
(vi) Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
(vii)Mechanical Vibrations — JP Den Hartog
(viii)Theory of Vibrations with Applications — WT Thomson

**Course Outcomes**

- To be uploaded

❖ **Laboratory - Introduction to Mechanics[ L : 0; T:0 ; P : 3 (1.5 credits)]**

Suggested list of experiments from the following:

- Coupled oscillators;
- Experiments on an air-track;
- Experiment on moment of inertia measurement,
- Experiments with gyroscope;
- Resonance phenomena in mechanical oscillators.

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## (iii) Quantum Mechanics for Engineers[L : 3; T:1; P : 0 (4 credits)]

| | |
|---|---|
| **Pre-requisites (if any)** | Mathematics course on differential equations and linear algebra |

**Detailed contents :**

***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 wavefunction, Born interpretation, probability current, Expectation values, Free-particle wavefunction and wave-packets, Uncertainty principle.

***Module 2: Mathematical Preliminaries for quantum mechanics (4 lectures)***

Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators, Hermite polynomials, Legendre's equation, spherical harmonics.

***Module 3: Applying the Schrodinger equation (15 lectures)***

Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator.

Numerical solution of stationary-state Schrodinger equation for one dimensional problems for different potentials

Scattering from a potential barrier and tunneling; related examples like alpha-decay, field-ionization and scanning tunneling microscope

Three-dimensional problems: particle in three dimensional box and related examples, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbitals, interaction with magnetic field, spin

Numerical solution stationary-state radial Schrodinger equation for spherically symmetric

potentials.

***Module 4: Introduction to molecular bonding (4 lectures)***
Particle in double delta-function potential, Molecules (hydrogen molecule, valence bond and molecular orbitals picture), singlet/triplet states, chemical bonding, hybridization

***Module 5: Introduction to solids (7 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
Numerical solution for energy in one-dimensional periodic lattice by mixing plane waves.

**Suggested Text Books**
(ii) Eisberg and Resnick, Introduction to Quantum Physics

**Suggested Reference Books**
(i) D. J. Griffiths, Quantum mechanics
(ii) Richard Robinett, Quantum Mechanics
(iii) Daniel McQuarrie, Quantum Chemistry

**Course Outcomes**
- To be uploaded

❖ **Laboratory - Quantum Mechanics for Engineers[ L : 0; T:0 ; P : 3 (1.5 credits)]**
Suggested list of experiments from the following:
Frank-Hertz experiment; photoelectric effect experiment; recording hydrogen atom spectrum

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## (iv)Oscillations, waves and optics[L : 3; T:1; P : 0 (4 credits)]

| | |
|---|---|
| **Pre-requisites (if any)** | (i) Mathematics course on Differential equations<br>(ii) Introduction to Electromagnetic theory |

**Detailed contents :**
***Module 1: Simple harmonic motion, damped and forced simple harmonic oscillator (7 lectures)***

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

***Module 2: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion (7 lectures)***

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigenfrequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves.

Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

***Module 3: The propagation of light and geometric optics (10 lectures)***

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave.

Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method

***Module 4: Wave optics (6 lectures)***

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

***Module 5: Lasers (8)***

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers ( He-Ne, $CO_2$), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

**Suggested Reference Books**

(i) Ian G. Main, Oscillations and waves in physics
(ii) H.J. Pain, The physics of vibrations and waves
(iii)E. Hecht, Optics
(iv)A. Ghatak, Optics
(v)O. Svelto, Principles of Lasers

❖ **Laboratory - Oscillations, waves and optics[ L : 0; T:0 ; P : 3 (1.5 credits)]**

Suggested list of experiments from the following:

- Diffraction and interference experiments (from ordinary light or laser pointers); measurement of speed of light on a table top using modulation; minimum deviation from a prism.

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| **Course code** | BSC103 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| **Course title** | **Maths -1** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester - I |
| | **3** | **1** | **0** | **4** | |
| **Pre-requisites (if any)** | **-** | | | | |

# (i)Calculus and Linear Algebra

**Detailed contents:**

***Module 1: Calculus: (6 lectures)***

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

***Module 2: Calculus: (6 lectures)***

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

***Module 3: Sequences and series: (10 lectures)***

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

***Module 4: Multivariable Calculus (Differentiation): (8 lectures)***

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

***Module 5: Matrices (10 lectures)***

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

**Suggested Text/Reference Books**

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(iii) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

(iv) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
(v) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
(vi) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
(vii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

**Course Outcomes**

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

The students will learn:

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- The tool of power series and Fourier series for learning advanced Engineering Mathematics.
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

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| **Course code** | BSC104 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| **Course title** | **Maths -2**<br>**(Calculus, Ordinary Differential Equations and Complex Variable )** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester-II |
| | **3** | **1** | **0** | **4** | |
| **Pre-requisites (if any)** | **-** | | | | |

## Calculus, Ordinary Differential Equations and Complex Variable

**Detailed contents**

***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: (6 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: (8 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: (8 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: (8 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.

**Suggested Text/Reference Books**

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
(ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
(iii) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
(iv) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
(v) E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
(vi) E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
(vii) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
(viii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
(ix) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

**Course Outcomes**
The objective of this course is to familiarize the prospective engineers with techniques in

multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

- The mathematical tools needed in evaluating multiple integrals and their usage.
- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

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| **Course code** | BSC105 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| **Course title** | **Maths (for Computer Science & Engg. students)**<br>**Paper – 1 Calculus and Linear Algebra** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | |
| | **3** | **1** | **0** | **4** | |
| **Pre-requisites (if any)** | **-** | | | | |

## Paper-1 Calculus and Linear Algebra

**Detailed contents :**

***Module 1: Calculus: (6 lectures)***

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

***Module 2: Calculus: (6 lectures)***

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

***Module 3: Matrices (in case vector spaces is to be taught) (8 lectures)***

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

***Module 4: Vector spaces (Prerequisite Module 3-Matrices ) (10 hours)***

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.

***Module 5: Vector spaces (Prerequisite Module 3 –Matrices & Module-4 Vector spaces) (10 lectures)***

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

**Suggested Text/Reference Books**

(i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
(ii) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
(iii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
(iv) Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
(v) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
(vi) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
(vii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
(viii) V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

**Course Outcomes**

The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

The students will learn:

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from various applications, they will have a basic understanding of Beta and Gamma functions.
- The essential tools of matrices and linear algebra including linear transformations, eigenvalues, diagonalization and orthogonalization.

********

| **Course code** | BSC106 | | | | |
|---|---|---|---|---|---|
| Category | Basic Science Course | | | | |
| **Course title** | **Maths (for Computer Science & Engg. Students)**<br>**Paper – 2 : Probability and Statistics** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | |
| | **3** | **1** | **0** | **4** | |
| **Pre-requisites (if any)** | - | | | | |

## Paper -2: Probability and Statistics

**Detailed contents**

***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:*** *(4 lectures)*

Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities.

***Module 3: Bivariate Distributions:*** *(4 lectures)*

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

***Module 4: Basic Statistics: (8 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: (8 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: (4 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.

**Suggested Text/Reference Books**

(i) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

(ii) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).

(iii) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

(iv) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

(v) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

(vi) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

(vii) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

**Course Outcomes**

The objective of this course is to familiarize the students with statistical techniques. It

aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

The students will learn:

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.

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| | | | | | |
|---|---|---|---|---|---|
| **Course code** | ESC103 | | | | |
| Category | Engineering Science Course | | | | |
| **Course title** | **Programming for Problem Solving(Theory&Lab.)** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester – II |
| | **3** | **0** | **4** | **5** | [The lab component should have one hour of tutorial followed or preceded by laboratory assignments.] |
| **Pre-requisites (if any)** | **-** | | | | |

## (i)Programming for Problem Solving ( [L : 3; T:0; P : 0 (3 credits)] [contact hrs : 40]

**Detailed contents**

***Unit 1***Introduction to Programming **(4 lectures)**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

***Unit 2:***Arithmetic expressions and precedence **(2 lectures)**

**Unit 2 :**Conditional Branching and Loops **(6 lectures)**

Writing and evaluation of conditionals and consequent branching **(3 lectures)**

Iteration and loops **(3 lectures)**

***Unit 3***Arrays **(6 lectures)**

Arrays (1-D, 2-D), Character arrays and Strings

***Unit 4***Basic Algorithms **(6 lectures)**

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

***Unit 5***Function **(5 lectures)**
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

***Unit 6***Recursion **(4 -5 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.

***Unit 7***Structure **(4 lectures)**
Structures, Defining structures and Array of Structures

***Unit 8***Pointers **(2 lectures)**
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

***Unit 9***File handling (only if time is available, otherwise should be done as part of the lab)

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

**Suggested Reference Books**
**(i)** 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.

**(ii)Laboratory - Programming for Problem Solving[ L : 0; T:0 ; P : 4 (2credits)]**
**[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** | HSMC 101 | | | | |
| Category | Humanities and Social Sciences including Management courses | | | | |
| **Course title** | **English** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester - II |
| | **2** | **0** | **2** | **3** | |
| **Pre-requisites (if any)** | **-** | | | | |

## English ( [L : 2; T:0; P : 2 (3 credits)]

**Detailed contents**

**1. Vocabulary Building**

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

**2. Basic Writing Skills**

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

**3. Identifying Common Errors in Writing**

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

**4. Nature and Style of sensible Writing**

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

**5. Writing Practices**

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

**6. Oral Communication**

(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:**

(i) *Practical English Usage.* Michael Swan. OUP. 1995.
(ii) *Remedial English Grammar.* F.T. Wood. Macmillan.2007
(iii)*On Writing Well.* William Zinsser. Harper Resource Book. 2001
(iv)*Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
(vi)*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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| **Course code** | ESC 102 | | | | |
|---|---|---|---|---|---|
| Category | Engineering Science Courses | | | | |
| **Course title** | **Engineering Graphics & Design (Theory & Lab.)** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester - I |
| | **1** | **0** | **4** | **3** | |
| **Pre-requisites (if any)** | **-** | | | | |

## Engineering Graphics & Design **[A total of 10 lecture hours & 60 hours of lab.]**

**[[L : 1; T:0; P : 4 (3 credits)]**

**Detailed contents**

***Traditional Engineering Graphics***:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

***Computer Graphics***:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

***(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)***

***Module 1: Introduction to Engineering Drawing***covering,
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

***Module 2: Orthographic Projections***covering,
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

***Module 3: Projections of Regular Solids***covering,
those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

***Module 4:Sections and Sectional Views of Right Angular Solids***covering,
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

***Module 5: Isometric Projections*** **covering,**
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

***Module 6: Overview of Computer Graphics***covering,
listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

***Module 7: Customisation & CAD Drawing***
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

***Module 8: Annotations, layering & other functions***covering
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line

lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

***Module 9: Demonstration of a simple team design project****that illustrates*
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

**Suggested Text/Reference Books:**

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii)Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
(iv)Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
(v) (Corresponding set of) CAD Software Theory and User Manuals

**Course Outcomes**

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn :

- Introduction to engineering design and its place in society

- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modelling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

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| **Course code** | ESC 104 | | | | |
|---|---|---|---|---|---|
| Category | Engineering Science Courses | | | | |
| **Course title** | **Workshop/Manufacturing Practices (Theory & Lab.)** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester-II |
| | **1** | **0** | **4** | **3** | |
| **Pre-requisites (if any)** | **-** | | | | |

## Workshop/Manufacturing Practices[ [L : 1; T:0; P : 0 (1 credit)]

**Lectures & videos: (10 hours)**

**Detailed contents**

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:**

(i) 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.

(ii) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

(iii)Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

(iv)Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

(v) Rao P.N., "Manufacturing Technology", Vol. I and 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.

**(ii) Workshop Practice:(60 hours)[ L : 0; T:0 ; P : 4 (2 credits)]**

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 & Glass Cutting (6 hours)

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** | ESC 101 | | | | |
|---|---|---|---|---|---|
| Category | Engineering Science Course | | | | |
| **Course title** | **Basic Electrical Engineering (Theory & Lab.)** | | | | |
| **Scheme and Credits** | **L** | **T** | **P** | **Credits** | Semester –I |
| | **3** | **1** | **2** | **5** | |
| **Pre-requisites (if any)** | **-** | | | | |

## (i)Basic Electrical Engineering [L : 3; T:1; P : 0 (4 credits)]

**Detailed contents :**

***Module 1 : DC Circuits (8 hours)***
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.

***Module 2: AC Circuits (8 hours)***
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.

***Module 3: Transformers (6 hours)***
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

***Module 4: Electrical Machines (8 hours)***
Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss 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.

***Module 5: Power Converters (6 hours)***
DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

***Module 6: Electrical Installations (6 hours)***
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.

**Suggested Text / Reference Books**

(i) D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
(ii) D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
(iii) L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
(iv) E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
(v) V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

**Course Outcomes**

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

**(ii)Basic Electrical Engineering Laboratory [ L : 0; T:0 ; P : 2 (1 credit)]**

**List of experiments/demonstrations:**

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

**Laboratory Outcomes**

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic converters.

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All India Council for Technical Education

Appendix A

# A Guide to Induction Program

## 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.*[1] *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

[1] A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31 March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs.

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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 awarness, sensitivity and understanding of the self, people around them, society at large, and nature.[2]

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]Induction Program as described here borrows from three programs running earlier at different institutions: (1) Foundation Program running at IIT Gadhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

(1) IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.

(2) IIIT Hyderabad was the first one to implement a compulsary course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all departments got involved in conducting the group discussions under the course. The content is non-sectarian, and the mode is dialogical rather than sermonising or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

(3) Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to in case of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one's relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member.

Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.

## 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 everyday 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 dont's, 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.[3]

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.

[3]The Universal Human Values Course is a result of a long series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT(BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.

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### 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 facilties.

## 3 Schedule

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.

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## 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.

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### 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[4].

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 (upto 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 meta-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

[4]We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept.

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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.

**References:**

*Motivating UG Students Towards Studies*,
Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors),
31 March 2016, IIT Directors' Secretariat, IIT Delhi.

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*18 June 2017*

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**ALL INDIA COUNCIL FOR TECHNICAL EDUCATION**

**Committee constituted on**
**Quick Revision of the Model Curriculum in Undergraduate Engineering Courses**

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