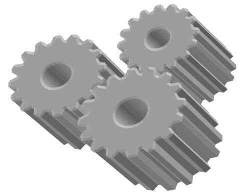

CURRICULUM

FOR

FIRST YEAR

UNDERGRADUATE DEGREE COURSES

IN

ENGINEERING & TECHNOLOGY

Jharkhand University of Technology

Ranchi, India

2018

Board of Studies for UG Courses
in
Engineering and Technology
Jharkhand University of Technology, Ranchi

External Member			
Sl. No.	**Name**	**Designation/Organization**	**Signature**
1.			
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Internal Member			
Sl.No.			
1.			
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Contents

COURSE STRUCTURE

SEMESTER I (FIRST YEAR]

Table 1: Branch/Course Common to all branches of UG Engineering & Technology

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		**IA**	ESE	Total
				Theory						
1	Basic Science Course	BSC101	Physics I	3	1	0	4	30	70	100
2	Basic Science Course	BSC103	Mathematics – I	3	1	0	4	30	70	100
3	Engineering Science Courses	ESC101	Basic Electrical Engineering	3	1	0	4	30	70	100
						Total(A)	**12**	90	210	300
				Practical/Drawing/Design						
4	Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3	25	25	50
5	Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5	25	25	50
6	Engineering Science Courses	ESC101P	Basic Electrical Engineering	0	0	2	1	25	25	50
						Total(B)	**5.5**	**75**	**75**	**150**
						Grand Total(A+B)	**17.5**	**165**	**285**	**450**

L-Lecture, T-Tutorial, P-Practical

IA- Internal Assessment, ESE-End Semester Examination

SEMESTER II (FIRST YEAR]

Table 2: Branch/Course: Common to all branches of UG Engineering & Technology

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		**IA**	ESE	Total
Theory										
1	Basic Science Course	BSC105	Physics II	2	1	0	3	30	70	100
2	Basic Science Course	BSC102	Chemistry I	3	1	0	4	30	70	100
3	Basic Science Course	BSC104	Mathematics – II	3	1	0	4	30	70	100
4	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70	100
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70	100
						Total(A)	**18**	150	350	500
Practical/Drawing/Design										
6	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	25	25	50
7	Basic Science Course	BSC102P	Chemistry I	0	0	3	1.5	25	25	50
8	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	25	25	50
						Total(B)	**5.5**	**75**	**75**	**150**
						Grand Total(A+B)	**23.5**	**225**	**425**	**650**

L-Lecture, T-Tutorial, P-Practical
IA- Internal Assessment, ESE-End Semester Examination

COMMON BASIC SCIENCES COURSES

Table 3: Physics, Chemistry & Mathematics

Sl. No.	Courses	Papers	Remark
1.	**Mathematics**	**Mathematics(Option 1)** Mathematics 1 Mathematics 2	For all branches of Engineering except CSE
		Mathematics (Option 2) Mathematics 1 Mathematics 2	For CSE only
2.	**Physics** (Theory & Lab.)	**Physics I** (i) Introduction to Electromagnetic Theory (ii) Introduction to Mechanics (iii) Introduction to Quantum Mechanics for Engineers (iv) Semiconductor Physics (v) Basics of Electricity Magnetism & Quantum Physics	For all branches of Engineering with the combination as suggested in the table 5
		Physics II (i) Semiconductor Optoelectronics (ii) Mechanics of Solid (iii) Oscillation, Waves and Optics (iv) Optics & Fiber Optics	
3.	**Chemistry** (Theory & Lab.)	**Chemistry – I (**Concepts in chemistry for engineering)	For all branches of Engineering

ENGINEERING SCIENCE COURSES &
HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES

Table 4:Engineering Science Courses & Humanities and Social Sciences Including Management Courses

Sl. No.	Course	Paper
1.	**ENGINEERING SCIENCE COURSES**	Programming for Problem Solving
		Engineering Graphics & Design
		Basic Electrical Engineering
		Workshop/ Manufacturing Practices
2.	**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES**	English

Table 5: Physics Papers for different Engineering Discipline

Branch	PHYSICS PAPER	Preferred Semester
Civil Engineering (CE)	Introduction to Mechanics	Semester I
	Mechanics of Solid	Semester II
Electrical & Electronics Engineering (EEE)	Introduction to Quantum Mechanics for Engineers	Semester I
	Oscillation, Waves and Optics	Semester II
Electronics & Communication Engineering (ECE)	Semiconductor Physics	Semester I
	Semiconductor Optoelectronics	Semester II
Mechanical Engineering (ME)	Introduction to Electromagnetic Theory	Semester I
	Mechanics of Solid	Semester II
Computer Science Engineering (CSE)	Semiconductor Physics	Semester I
	Semiconductor Optoelectronics	Semester II
Chemical Engineering	Basics of Electricity Magnetism and Quantum Physics	Semester I
	Optics & Fiber Optics	Semester II
Metallurgical Engineering & Materials Science (MEMS)	Introduction to Mechanics	Semester I
	Mechanics of Solid	Semester II

SEMESTER I

COURSE CONTENTS

<table>
<tr><td>Course Code</td><td colspan="5">BSC 103</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Mathematics - I
Calculus and Linear Algebra (Option 1) for All Branch excluding CSE
Calculus and Linear Algebra (Option 2) for CSE</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester I</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Pre-requisites: High-school education</td></tr>
</table>

MATHEMATICS 1

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CALCULUS AND LINEAR ALGEBRA 40 Lectures

Option 1 (For all branches) excluding CSE

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Module 1: Calculus-I **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-II **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, skewsymmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Textbooks/References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

COURSE OUTCOMES

To introduce the idea of applying differential and integral calculus to notions of curvature and to improper integrals.

To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.

To familiarize the student with functions of several variables that is essential in most branches of engineering.

To develop the essential tool of matrices and linear algebra in a comprehensive manner.

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CALCULUS AND LINEAR ALGEBRA **Option 2 (for CSE)** **40Lectures**

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Module 1: Calculus-I **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-II **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 **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-I **10 Lectures**

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-II **10 Lectures**

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

Textbooks/References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- 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.
- 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 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.

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<table>
<tr><td>Course Code</td><td colspan="5">BSC 101</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Physics-I
(i) Introduction to Electromagnetic Theory – For ME
(ii) Introduction to Mechanics – For Civil, MEMS
(iii) Introduction to Quantum Mechanics for Engineers - For EEE
(iv) Semiconductor Physics – For ECE, CSE
(v) Basics of Electricity, Magnetism & Quantum Mechanics- For Chemical Engg.</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester I</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Mathematics course with vector calculus, High-school education
Mathematics course on differential equations and linear algebra</td></tr>
</table>

PHYSICS- I

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INTRODUCTION TO ELECTROMAGNETIC THEORY **For ME**

38 Lectures

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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; Boundary conditions on **B** and **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 and Maxwell's equations **9 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.

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 quasistatic 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 6: 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.

Text Book:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.

Reference books:

- Fundamentals of Physics Electricity and Magnetism, Halliday and Resnick, tenth edition (published 2013).
- W. Saslow, Electricity, magnetism and light, 1st edition
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

COURSE OUTCOMES

To make student understand the basic of electrostatics in vacuum and in material medium.

To make student understand the basic of magnetostatics in vacuum and in magnetic material medium.

Students to get familiarized with the Faraday's Law and Maxwell's equation leading to the application of EMW in vacuum and in media.

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INTRODUCTION TO MECHANICS

for Civil, MEMS
38 Lectures

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Module 1: Particle motion and Newton's law **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: Central potential and Kepler's laws **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: Rotating coordinate system **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: Harmonic Oscillations **6 Lectures**

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

Module 5: Planar rigid body mechanics **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: Three-dimensional rigid body motion **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.

Reference books:

- Engineering Mechanics, 2nd ed. Publisher: Cengage Learning; 2 edition (January 22, 2013) - MK Harbola
- Introduction to Mechanics, CRC Press - MK Verma
- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill
- Principles of Mechanics. by Synge, John. L; Griffith, Byron. A. Publication date Publisher McGraw-Hill
- Mechanics - JP Den Hartog
- Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
- Mechanical Vibrations - JP Den Hartog
- Theory of Vibrations with Applications - WT Thomson

COURSE OUTCOMES

Students to learn basics of particle dynamics including the rotational motion in central potential field following Kepler's laws.

To learn the rotating co-ordinate system and harmonic motion with the effect of damping and forced oscillation.

INTRODUCTION TO QUANTUM MECHANICS FOR ENGINEERS **For EEE**

38 Lectures

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 **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 **5 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.

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; 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 5: 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 6: 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.

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 PHYSICS **For ECE, CSE**
38 Lectures

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Module 1: Electronic materials **8 Lectures**

Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.

Module 2: Semiconductors **10 Lectures**

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

Module 3: Light-semiconductor interaction **7 Lectures**

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

Module 4: Measurements **7 Lectures**

Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis spectroscopy, absorption/transmission.

Module 5: Engineered semiconductor materials **6 Lectures**

Density of states in 2D, 1D and 0D (qualitatively). Practical examples of low-dimensional systems such as quantum wells, wires, and dots: design, fabrication, and characterization techniques. Hetero junctions and associated band-diagrams

References:

- J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
- B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
- S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).

- Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (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 and Devices" by Monica Katiyar and Deepak Gupta on NPTEL

COURSE OUTCOMES

Students will be exposed to the understanding of semiconductor materials and their importance in Computer, Electronics and Communication Engineering.
To learn the interaction of light and semiconductor.
To get familiarized with the measurement techniques on semiconductor devices and circuits.

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BASICS OF ELECTRICITY, MAGNETISM AND QUANTUM PHYSICS
For Chemical Engg. **38 Lectures**

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Module 1: Electromagnetism **8 Lectures**
Laws of electrostatics: Coulomb's and Gauss's Law, electric current and the continuity equation, laws of magnetism. Ampere's Law, Faraday's laws of electromagnetic induction: Self and mutual induction, motional and changing field emf, Displacement current, Maxwell's equations.

Module 2: Dielectrics **6 Lectures**
Dielectric, Polar and non-polar dielectrics, Electric Polarisation, Polarizability, Types of polarization, Permittivity and dielectric constant, internal fields in a solid, Clausius-Mossotti equation:, applications of dielectrics.

Module 3: Magnetic Substances **7 Lectures**
Magnetic moment and Magnetisation, permeability and susceptibility, classification of magnetic materials, diamagnetic, paramagnetic and ferromagnetic, magnetic domains and hysteresis, hysteresis loss, applications.

Module 4: Basic Quantum Mechanics **7 Lectures**

Inadequacy of Classical Mechanics, Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect: Stopping Potential, Work Function, Compton Effect: Compton Shift.

Module 5: Wave particle duality and bound states **10 Lectures**

de Broglie hypothesis, Bragg's Law, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation: time dependent and independent form, eigen value and eigen function, normalization of wave function, particle in a box, quantum harmonic oscillator, hydrogen atom.

Text Book:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.

Reference books:

- Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.

COURSE OUTCOMES

Students to get basic knowledge of Electromagnetism, dielectrics, magnetic materials etc.

Familiarization with the basics of Quantum Mechanics and its application to few bound states.

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PHYSICS LABORATORY **Code: BSC101P**

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Choice of 08-10 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
- Coupled oscillators
- Experiments on an air-track
- Experiment on moment of inertia measurement
- Experiments with gyroscope
- Resonance phenomena in mechanical oscillators
- Frank-Hertz experiment
- Photoelectric effect experiment
- Recording hydrogen atom Spectrum
- 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

LABROTARY OUTCOMES

Students to have hands on experiences with experiments on the basics laws and principles of Physics in the field of Mechanics, Optics, Electricity, Magnetism, Modern Physics, etc.

<table>
<tr><td>Course Code</td><td colspan="5">ESC 101</td></tr>
<tr><td>Category</td><td colspan="5">Engineering Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Basic Electrical Engineering</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester I</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Intermediate level Electricity</td></tr>
</table>

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BASIC ELECTRICAL ENGINEERING 40 Lectures

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Module 1 : DC Circuits **7 Lectures**

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 **7 Lectures**

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 Lectures**

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 Lectures**

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 Lectures**

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations **6 Lectures**

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

- D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
- D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
- L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
- E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
- 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.

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BASIC ELECTRICAL ENGINEERING LABORATORY Code: ESC101P

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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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Course Code	**ESC 102**				
Category	**Engineering Science Course**				
Course Title	**Engineering Graphics & Design (Theory & Lab)**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	1	**0**	**4**	**3**	
Pre-requisites	**Basic knowledge of Computer and Solid Geometry**				

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ENGINEERING GRAPHICS & DESIGN

Lecture - 10 hours & Lab - 60 hours

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Traditional Engineering and Computer Graphics: **10 Lectures**

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.

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

(Lab modules also include concurrent teaching)

Lab Module 1: Introduction to Engineering Drawing **5 Lectures**

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;

Lab Module 2: Orthographic Projections **5 Lectures**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Lab Module 3: Projections of Regular Solids **5 Lectures**

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.

Lab Module 4: and Sectional Views of Right Angular Solids **5 Lectures**

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)

Lab Module 5: Isometric Projections **6 Lectures**

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;

Lab Module 6: Overview of Computer Graphics **8 Lectures**

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];

Lab Module 7: Customization & CAD Drawing **8 Lectures**

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;

Lab Module 8: Annotations, layering & other functions **9 Lectures**

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 ommand; 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;

Lab Module 9: Demonstration of a simple team design project **9 Lectures**

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:

- Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engg Drawing, Charotar Pub House
- Shah, M.B. & Rana B.C. (2008), Engg Drawing & Comp. Graphics, Pearson Education
- Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
- Narayana, K.L. & P Kannaiah (2008), Text book on Engg Drawing, Scitech Publishers
- 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 modeling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

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SEMESTER II COURSE CONTENTS

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<tr><td>Course Code</td><td colspan="5">BSC 104</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Mathematics – II
Contents
Calculus, Ordinary Differential Equations and Complex Variable (Option 1) for All branches excluding CSE
Probability and Statistics (Option I1) for CSE</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester
II</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Elementary Knowledge of calculus, Probability and Statistics</td></tr>
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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

To 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 are used in various techniques dealing engineering problems.

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Course Code	**BSC 105**				
Category	**Basic Science Course**				
Course Title	**Physics-II** **Course contents in Physics** (i) Oscillations, Waves and Optics – For EEE (ii) Semiconductor Optoelectronics – For ECE, CSE (iii) Mechanics of Solid – For Civil, ME, MEMS (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 Introduction to Electromagnetic Theory Semiconductor Physics				

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OSCILLATIONS, WAVES AND OPTICS **For EEE**

38 Lectures

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Module 1: Harmonic Oscillation **07 Lectures**

Simple harmonic motion, damped and forced simple harmonic oscillator 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: Waves **07 Lectures**

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion 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 eigen frequencies, 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: 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 **06 Lectures**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhoffer 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 **08 Lectures**

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.

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, A. Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

COURSE OUTCOME

Students to learn harmonic oscillations, physical and wave optics.

Students to get familiarize with the knowledge of waves and Lasers.

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SEMICONDUCTOR OPTOELECTRONICS **For ECE, CSE**
36 Lectures

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Module 1: Review of semiconductor physics **10 Lectures**

E-k diagram, Density of states, Occupation probability, Fermi level and quasi-Fermi level (variation by carrier concentration and temperature); 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**

Review of laser physics; 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; DFB, DBR, and vertical-cavity surface-emitting lasers (VECSEL), Tunable semiconductor lasers.

Module 4: Photo-detectors **06 Lectures**

Types of semiconductor photodetectors -p-n junction, PIN, and Avalanche -- and their structure, materials, working principle, and characteristics, Noise limits on performance; 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 with examples 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; Illustrations through simple problems on axially loaded members like trusses.

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; Strain RoseOe;

Module 3: Material behavior **7 Lectures**

Discussion of experimental results on 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; Complete equations of elasticity;

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); Torsion of circular shafts and thin-walled tubes (plastic analysis and rectangular shafts not to be discussed); 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); Castigliano's theorems for deflection analysis and indeterminate problems.

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** **Contents** (i) Chemistry-I (Concepts in chemistry for engineering) (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

<table>
<tr><td>Course Code</td><td colspan="5">ESC 103</td></tr>
<tr><td>Category</td><td colspan="5">Engineering Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Programming for Problem Solving</td></tr>
<tr><td rowspan="2">Scheme & Credits</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td rowspan="2">Semester II</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Knowledge of Computer and Mathematics</td></tr>
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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** **(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 & 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	**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**				

ENGLISH 38 Lectures

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 facilties.

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.