DEPARTMENT OF APPLIED PHYSICS
INDIAN SCHOOL OF MINES, DHANBAD

COURSE STRUCTURE & SYLLABUS FOR 4-YEARS
B. Tech.
IN
ENGINEERING PHYSICS
WITH
HONORS & MINOR

Effective from 2014-15

First Year (Semester I/II)

Sl. No.	Course Code	Course Name	Course Offering Dept.	L	T	P	Credit Hrs	Contact hours
1.	AMC 11101	Mathematics-I (only for 1st Sem)	AM	3	1	0	7	4
2.	AMC 12101	Mathematics-II (only for 2nd Sem)	AM	3	1	0	7	4
3.	APC 11101/ ACC 11101	Physics (Group-I)/ Chemistry (Group-II)	AP/AC	3	0	0	6	3
4.	MMC 11101/ MMC 11102	Engineering Graphics (Group-I)/ Manufacturing Process (Group-II)	ME & MME	1	4	0	6	5
5a.	EEC 11101	Electrical Technology (Group-I)	EE	3	1	0	7	4
5b.	ECE 11101	Electronics Engineering (Group-II)	ECE	3	0	0	6	3
6a.	MMC 11103	Engineering Mechanics (Group-I)	ME & MME	3	1	0	7	4
6b.	CSE 11301	Computer Programming (S) (Group-II)	CSE	3	0	0	6	3
7.	GLD/CMD 11301/ MSD/APD 11301	Earth System Science (S) [AGL 2-0-01 & ESE 1-0-0] (Group-I) /Disaster Management [MSD 2-0-0] & Energy Resources [APD 1-0-0] (S) (Group-II)	AGL & ESE/ DMS & AP	3	0	0	6	3
8.	HSC 12305/ HSC 11103	Value Education, Human Rights and Legislative Procedure (S) (Group-I)/ English for Science & Technology (Group-II)	HSS	3	0	0	6	3
9.	SWC12701	Co-Curricular Activities (Only for 2nd Sem)	DSW	0	0	0	3	0

Practical

10.	APC 12201/ ACC 12201	Physics Practical (Group-I)/ Chemistry Practical(Group-II)	AP/AC	0	0	3/2	1.5	1.5
11.	EEC 12201/ ECE 12201	Electrical Technology Practical(Group I)/ Electronics Engineering Practical (Group-II)	EE/ECE	0	0	3/2	1.5	1.5
12.	CSE 12301	Computer Programming Practical (S)(Group-II)	CSE	0	0	2	2	2

Total for Semester I (For Group-I)	**19**	**7**	**3**	**48**	**29**
Total for Semester I (For Group-II)	**19**	**5**	**5**	**48**	**29**
Total for Semester II (For Group-I)	**19**	**7**	**3**	**48 +(3)**	**29**
Total for Semester II (For Group-II)	**19**	**5**	**5**	**48+(3)**	**29**

Second Year (Semester III)

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APC13101	Waves and Acoustics	3	1	0	7	4
2.	EIC 13103	Signals and Networks	3	1	0	7	4
3.	MMC13102	Engineering Thermodynamics	3	1	0	7	4
4.	AMR13101	Methods of Applied Mathematics-I	3	1	0	7	4
5.	CSR13101	Data Structures	3	0	0	6	3
6.	APC13201	Physics Lab-I	0	0	3	3	3
7.	MMC13202	Engineering Thermodynamics Lab	0	0	2/2	2/2	1
8.	APC13801	Project-I	0	0	2	2	2
		Total	**15**	**4**	**6**	**40**	**25**

Second Year (Semester IV)

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APC14101	Classical Mechanics	3	1	0	7	4
2.	APC14102	Mathematical Physics	3	1	0	7	4
3.	APC14103	Applied Optics	3	1	0	7	4
4.	AMR14101	Numerical and Statistical Methods	3	1	0	7	4
5.	EER 14101	Applied Electrical Engineering	3	0	0	6	3
6.	APC14201	Physics Lab-II	0	0	3	3	3
7.	APC14202	Physics Lab-III	0	0	3	3	3
8.	APC14801	Project-II	0	0	2	2	2
9.	APC14901	Summer Training-I (marks to be added in next semester)					
10.	SWC14701	Co-Curricular Activity-II	0	0	0	3	0
		Total	**15**	**4**	**8**	**45**	**27**

Third Year (Semester V)

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APC15101	Quantum Mechanics	3	0	0	6	3
2.	APC 15102	Analog and Digital Electronics	3	0	0	6	3
3.	APC15103	Electrodynamics	3	0	0	6	3
4.	MSC15152	Industrial Engineering and Management	3	0	0	6	3
5.	APC15201	Physics Lab-IV	0	0	3	3	3
6.	APC15801	Project-III	0	0	3	3	3
7.	APC15901	Summer Training-I	0	0	0	5	0
		Total	**12**	0	**6**	**35**	**18**

Third Year (Semester VI)

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APC16101	Nuclear Science and Engineering	3	0	0	6	3
2.	APC16102	Atomic and Molecular Physics	3	0	0	6	3
3.	APC16103	Solid State Physics	3	0	0	6	3
4.	EIC16103	Digital Signal Processing	3	0	0	6	3
5.	APC16801	Project-IV	0	0	3	3	3
6.	APC16901	Summer Training-II (marks to be added in next semester)					
		Total	**12**	**0**	**3**	**27**	**15**

Fourth Year (Semester VII)

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APC17101	Statistical Mechanics	3	0	0	6	3
2.	APC17102	Physics of Nanomaterials	3	0	0	6	3
3.	APC17103	Thin Film Technology	3	0	0	6	3
4	APC17104	Optical Communication	3	0	0	6	3
5.	APC17801	Project-V	0	0	6	6	6
6.	APC17901	Summer Training-II	0	0	0	5	0
7.	APC17401	Seminar	0	0	0	6	0
		Total	**12**	**0**	**6**	**41**	**18**

Fourth Year (Semester VIII)

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APC18101	Photonics and Optoelectronics	3	0	0	6	3
2.	APC18102	Characterization Techniques	3	0	0	6	3
3.	APC18103	Laser Physics and Technology	3	0	0	6	3
4.	APC18104	Computational Physics	3	0	0	6	3
5.	APC18801	Project-VI	0	0	6	6	6
6.	APC18501	Grand Viva-Voce	0	0	0	4	0
		Total	**12**	**0**	**6**	**34**	**18**

Honors Course

Semester V

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APH15101	Sensors and Transducers	3	0	0	6	3

Semester VI

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APH16101	Low Temperature Physics and Superconductivity	3	0	0	6	3
2.	APD16301	Biomedical Engineering (S)	3	0	0	6	3

Semester VII

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APH17101	Plasma Engineering*	3	0	0	6	3
2.	APH17102	Astrophysics and Cosmology*	3	0	0	6	3
		* The student may choose any one paper.					
3.	APD17301	Non-Linear Optics (S)	3	0	0	6	3

Out of two sessional papers in Semester VI, and VII, the student is allowed to choose **minimum one sessional paper**.

Semester VIII

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APH18101	Nanotechnology	3	0	0	6	3
2.	APH18201	Advanced Physics Lab	0	0	0	3	3

Minor Courses

Semester V

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APM15101	Waves and Acoustics	3	0	0	6	3
2.	APM15102	Quantum Mechanics	3	0	0	6	3
3.	APM15103	Electrodynamics	3	0	0	6	3

Semester VI

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APM16101	Classical Mechanics	3	0	0	6	3
2.	APM16102	Mathematical Physics	3	0	0	6	3
3.	APM16103	Applied Optics	3	0	0	6	3
4.	APM16104	Atomic and Molecular Physics	3	0	0	6	3
5.	APM16105	Solid State Physics	3	0	0	6	3
6.	APD16301	Biomedical Engineering (S)	3	0	0	6	3

Semester VII

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APM17101	Statistical Mechanics	3	0	0	6	3
2.	APM17102	Physics of Nanomaterials	3	0	0	6	3
3.	APM17103	Thin Film Technology	3	0	0	6	3
4.	APM17104	Optical Communication	3	0	0	6	3
5.	APD17301	Non-Linear Optics (S)	3	0	0	6	3

Semester VIII

Sl. No	Course Code	Name of the Course	L	T	P	Credit hours	Contact hours
1.	APM18101	Nuclear Science and Engineering	3	0	0	6	3
2.	APM18102	Photonics and Optoelectronics	3	0	0	6	3
3.	APM18103	Characterization Techniques	3	0	0	6	3
4.	APM18104	Laser Physics and Technology	3	0	0	6	3
5.	APM18105	Computational Physics	3	0	0	6	3

The student is allowed to choose **one theory paper** in each semester and **two sessional papers listed** above in Semester VI and VII.

SEMESTER-I/II

AMC 11101 MATHEMATICS- I (3–1–0)

Calculus-I: Successive differentiation of one variable and Leibnitz theorem, Taylor's and Maclaurins expansion of functions of single variable. Functions of several variables, partial derivatives, Euler's theorem, derivatives of composite and implicit functions, total derivatives, Jacobian's, taylor's and Maclaurin's expansion of functions of several variables, Maxima and minima of functions of several variables, Lagrange's method of undetermined multipliers. Curvature and asymptotes, concavity, convexity and point of inflection. Curve tracing.

Calculus-II: Improper integrals, convergence of improper integrals, test of convergence, Beta and Gamma functions and its properties, Differentiation under integral sign; differentiation of integrals with constant and variable limits; Leibnitz rule.
Evaluation of double integrals, Change of order of integrations, change of coordinates, evaluation of area using double integrals, Evaluation of triple integrals, change of coordinates, evaluation of volumes of solids and curved surfaces using double and triple integrals. Mass, center of gravity, moment of inertia and product of inertia of two and three-dimensional bodies and principal axes.

Trigonometry of Complex Number, 3D Geometry and Algebra: Function of complex arguments, Hyperbolic functions and summation of trigonometrical series. 3D Geometry: Cones, cylinders and conicoids; Central conicoids, normals and conjugate diameters.

Algebra: Convergency and divergency of Infinite series. Comparison test, D' Alembert's Ratio test, Raabe's test, logarithmic test, Cauchy's root test. Alternating series; Leibnitz test, absolute and conditional convergence, power series, uniform convergence.

AMC 12101 MATHEMATICS- II (3–1–0)

Vector Calculus and Fourier Series:
Vector Calculus: Scalar and vector fields, Level surfaces, differentiation of vectors, Directional derivatives, gradient, divergence and curl and their physical meaning, vector operators and expansion formulae, Line, surface and volume integrations, Theorems of Green, Stokes and Gauss, Application of vector calculus in engineering problems, orthogonal curvilinear coordinates, expressions of gradient, divergence and curl in curvilinear coordinates.

Fourier Series: Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier series, Perseval's formula, complex form of Fourier series.

Matrix Theory: Orthogonal, Hermitian, skew-Hermitian and unitary matrices, Elementary row and column transformations, rank and consistency conditions and solution of simultaneous equations, linear dependence and consistency conditions and solution of simultaneous equations, linear dependence and independence of vectors, Linear and orthogonal transformations, Eigen values and Eigen vectors, properties of Eigen values, Cayley-Hamilton theorem, reduction to normal forms, quadratic forms, reduction of quadratic forms to canonical forms, index, signature, Matrix calculus & its applications in solving differential equations.

Differential Equations: Differential Equations of first order and higher degree, Linear independence and

dependence of functions. Higher order differential equations with constant coefficient, Rules of finding C.F. and P.I., Method of variation of parameter, and method of undetermined coefficients, Cauchy and Legendre's linear equations. Linear differential equations of second order with variable coefficients; change of dependent variable, change of independent variable, linear equations of special types; dependent variable absent, independent variable absent. Simultaneous linear equations with constant coefficients. Various applications of higher order differential equations in solution of engineering problems.

Partial Differential equations: Formation of P.D.E, Equations solvable by direct integration, Linear and non-linear equations of first order, Lagrange's equations, and Charpit's method. Homogeneous and non-homogeneous linear P.D.E. with constant coefficients. Rules for finding C.F. & P.I.

APC11101/APC12101 PHYSICS (3–0–0)

Thermal Physics: Concepts of distribution of molecular velocities; Distribution laws and statistics MB, FD and BE, mean free path; Transport phenomena-viscosity, diffusion; thermal conductivity, measurement of thermal conductivity; periodic and aperiodic flow of heat; Wiedemann-Franz law. Heat radiation; black body and black body radiation; Planck's distribution law and its application to classical distribution (Rayleigh-Jeans and Wiens) and total radiation (Stefan-Boltzmann) laws.

Modern Physics: Brief idea of molecular spectra; Rigid rotator, spectra of simple molecules, rotation and rotation-vibration spectra. Brief idea of wave pocket and wave function, Schrodinger equation, Particle in a Box. Free electron theory; qualitative idea of band theory of solids and Hall effect, Laser and laser systems (He-Ne and Ruby Lasers).

Electromagnetics and Electrical Phenomena in Rocks: Maxwell's field equation, Equation of electromagnetic field, Propagation of electromagnetic waves in different isotropic media, energy of electromagnetic waves, Poynting's theorem & Poynting's vector. Rocks and minerals as dielectrics, electrical conductivity and electrical phenomena in rocks, Piezo-, ferro-, tribo-, and pyro-electricity.

Reference Books:

1. Heat And Thermodynamics; Brij Lal & Subrahmanyam; S Chand & Co Ltd; 2001
2. Thermal And Statistical Physics; R B Singh; New Age Publications; 2009
3. An Introduction To Thermal Physics; Schroeder; Dorling Kindersley India; 2007
4. Thermal Physics And Statistical Mechanics; Roy & Gupta; New Age Publications; 2001
5. Concepts Of Modern Physics; Beiser; McGraw-Hill Science; 2010
6. Modern Physics; Sivaprasath & Murugeshan; S. Chand Publisher; 2009

ACC11101/ACC12101 CHEMISTRY (3–0–0)

Chemical Dynamics: Rates of simple and complex chemical reactions; Fast reactions; rate expressions for second order reactions, homogeneous and heterogenous catalysis and their importance.

Solid Fuels: Structure of coal, classification of coal, Effect of heat on coal, carbonization and pyrolysis. Recovery and purification of by-products obtained from coke ovens; Distillation of coal tar; coal chemicals.

Liquid Fuels: Composition of crude oil, processing of crude oil, distillation, sweetening and cracking (basic concepts), octane number, Additives to improve the quality of diesel and petrol, bio-diesel.

Gaseous Fuels: Characteristics of good fuel; calorific value, theoretical calculations of calorific value of a fuel, natural gas and hydrogen gas.

Phase rule and phase equilibrium diagram: Phase rule; degree of freedom, one and two component systems, temperature and composition diagrams, liquid-liquid and liquid-solid phase diagrams.

Lubricants: General characteristics of lubricants, chemistry of lube oil and greases. Reclamation of lubricants.

Equilibrium: Electrochemistry: Electric potentials at interfaces, electrodes, batteries, electrochemical cells, Fuel cells and their applications.

Corrosion: Chemical and electrochemical corrosion, classification, factors affecting corrosion, Form of corrosion and general methods of corrosion prevention.

MMC 11101/12101 ENGINEERING GRAPHICS (1–3–0)

Drawing instruments and their uses: Indian standards for drawing. Lettering; Types of lines used in engineering graphics: full lines, hidden lines, dimension lines, centerlines, section lines construction lines etc.

Scales: representative fractions, reducing and enlarging scales, plain scales, diagonal scales and vernier scales.

Curves used in engineering practice: conic sections, ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involutes and spiral.

Orthographic projections: First angle and third angle projections, conventions used, orthographic projections of simple solids; Conversion of three-dimensional views to orthographic views.

Isometric projections: of simple solids, isometric views, conversion of orthographic views to isometric views; free hand sketching.

MMC 11102/12102 MANUFACTURING PROCESS (1–3–0)

Carpentry: Classification of timber, seasoning and preservation of wood, description and applications of the various tools used in carpentry, different joints and their practical uses.

Forging: Introduction to Forging, types of tools and their uses, colour representations of different temperature levels, recrystallisation, workability of metals at elevated temperature, safety rules. Casting: Introduction to foundry, Pattern making, types of casting processes, purpose of runner & riser, applications of casting, defects in casting.

Fitting: Introduction to fitting jobs, fitting tools and their uses, safety rules. **Welding:** Welding types, accessories, weldments, safety rules.

Machine Tools: Types of tools, Types of Machine Tools and their specifications, safety rules.
Measurement: Use of vernier etc for product measurement.

EEC 11101/12101 ELECTRICAL TECHNOLOGY (3–1–0)

Network theorems: (KCL, KVL, Thevenin, Norton, Maximum power transfer) applied to steady-state DC circuit. Single-phase AC circuits and phasor diagrams, series and parallel resonance. Three-phase balanced and unbalanced AC circuits, phasor representation, measurement of three-phase power by two wattmeter method.

Magnetic circuit - Single-phase transformer: Construction, types, EMF equation, equivalent circuit, phasor diagram, OC and SC tests, regulation, efficiency.

DC Machines: Construction, types, principle of operation, EMF and torque equation, efficiency.
DC generator: OCC and external characteristic curves.

DC motors: speed-torque characteristics, starting, 3-point starter, speed control of separately excited DC motors.

Three-phase induction motor: Construction, types, principle of operation, torque-slip characteristics, starting methods

ECE 11101/12101 ELECTRONICS ENGINEERING (3–1–0)

Semiconductor Diodes and Applications: Introduction Characteristics, dc and ac resistances of a Diode. Half wave and Full wave Rectification. Zener Diodes and then use as regulators, Clippers and Clampers.

Bipolar junction Transistor: Introduction, Transistor Operator CB, CE and CC configuration, dc biasing, Operating point, Fixed biased Circuit, Emitter –Stablized Bias Circuit, Voltage Divider Bias.

BJT Transistor: Amplification in ac domain, Equivalent transistor model. Hybrid Equivalent model, RC coupled amplifier and its frequency response.

Operational Amplifiers: Introduction, Differential and Common Mode Operation, OPAMP Basics, Practical OPMAP Circuits.

Feedback and Oscillator Circuits: Feedback concepts, Feedback connection types, Oscillator operation, Phase Shifts Oscillator.

Digital Electronics: Review of Basic Gates and Boolean Algebra, Introduction to Combinational Logic Design. Standard Representations of Logical functions and their Simplification. Combinational Logic Design, Half Adder and Full Adders.

Sequential Circuits: Flip flops: S-R, J-K and D Application in Ripple Counters.

MMC 11103/12103 ENGINEERING MECHANICS (3–1–0)

Fundamentals of Mechanics: Equivalent force system, Equation of equilibrium, **Introduction to Structural Mechanics:** Force analysis of Frames, Trusses, Shear force, Bending moment analysis of Beams.

Friction force analysis: Laws, Sliding and Rolling friction, Screw Jack, Wedge, Belt friction, Collar friction.

Properties of surfaces: First moment of area and the centroid, Second moment and product of area, Transfer theorem, Polar moment of inertia.

Introduction of variational mechanics, Kinematics of particles: Velocity and acceleration calculations, Relative motion.

Particle dynamics: Rectilinear translation, Rectangular and cylindrical coordinates.

Energy methods: Conservation of mechanical energy, Work energy equations.

Linear momentum and moment of momentum: Impulse and momentum relations for a particle, Moment of momentum equation for a single particle and for a system of particles.

Introduction to kinematics and kinetics of rigid bodies. Mechanical vibration of single degree of freedom system.

HSC 11101/12101 ENGLISH FOR SCIENCE AND TECHNOLOGY (3–1–0)

Language resource development: Using appropriate grammatical lexical forms to express meaning-accuracy, range and appropriacy grammatical lexical exercises.

Reading, Interpreting and Using Written and Graphic information: Using (reading and writing) academic texts, articles in technical journals, instruction manuals/laboratory instruction sheets, safety manuals and regulations, and reports; Using maps, Graphs, plan diagrams, flow-charts, sketches, tabulated and statistical data.

Writing Appropriately in a Range of Rhetorical Styles i.e. Formal and Informal: Writing instructions, describing objects and processes; defining, narrating, classifying exemplifying, comparing, contrasting, hypothesizing, predicting, concluding, generalizing, restating and reporting; Note making (from books/journals);Writing assignments; summarizing, expanding, paraphrasing; Answering examination questions; Correspondence skills; Interpreting, expressing and negotiating meaning; Creating coherent written texts according to the conventions.

Receiving and Interpreting the Spoken Word: Listening to lectures and speeches, listening to discussions and explanations in tutorials; Note taking (from lectures); Interacting orally in academic, professional and social situation; Understanding interlocutor, creating coherent discourse, and taking appropriate turns in conversation; Negotiating meanings with other (in class room, workshop laboratory, seminar, conference, discussion, interview etc.).

GLD 11301/12301 **(2–0–0)**
ESD 11301/12301 **EARTH SYSTEM SCIENCE** **(1–0–0)**

AGL: (2-0-0)

Space Science: Solar System, Age of the Earth, Origin of Solar system. Meteors and Meteorites.

Earth Dynamics: Interior of the Earth, Composition of the Earth, Seismic waves, Seismograph, Plate Tectonics, Basics of Earthquake Engineering, Landslides, Volcanoes.

Geological Oceanography: Sea waves, Tides, Ocean currents, Geological work of seas and oceans, Tsunami and its causes, Warning system and mitigation.

Hydrogeology: Water table, Aquifer, Groundwater fluctuations and groundwater composition, Hydrologic cycle.

Glaciology: Glacier types, Different type of glaciers, Landforms formed by glacier.

Earth's Atmosphere: Structure and composition of atmosphere, Atmospheric circulation, Geological work of wind, Greenhouse effect and global warming, Carbon dioxide sequestration.

Biosphere: Origin of life, Evolution of life through ages, Geological time scale.

Earth Resources: Renewable and non-renewable resources, Mineral and fossil fuel resources and their geological setting.

Geological bodies and their structures: Rock, Mineral, Batholith, Dyke, Sill, Fold, Fault, Joint, Unconformity.

ESE: (1-0-0)

The Third Planet (two weeks)

Formation of the Earth: The origin of the solar system; Origin of the earth; Age of the earth. Heat balance of the earth.

The Solid Earth (three weeks)

Evolution of Earth Systems: Rocks and minerals. The interior of the earth, Early earth differentiation; Geological differentiation.

The Dynamic Earth: Plate Tectonics-evidences and consequences. Plate boundaries-divergent, convergent and transform plate boundaries; Volcanoes and Earthquakes.

Earth's Atmosphere (three weeks)

Structure and composition of the atmosphere; Atmospheric circulation; Forces and winds; Weather and climate; climate changes; Regulators of climate changes; El-Nino and its effect; Carbon cycle; Radiation budget; Green house effect and Global warming.

Earth's Oceans (two weeks)

The ocean-structure, composition and circulation; wind driven circulation; Oceans and coastal processes; Tsunami.

The Hydrosphere (one week)

The hydrologic cycle, water reservoirs.

The Biosphere (one week)

Origin of life on the earth; early life on the earth; biodiversity and extinction.

Earth Resources (one week)

Renewable and non-renewable resources. Uniqueness of non-renewable earth resources; their formation mechanisms and typical life cycles.

MSD 11301/12301 DISASTER MANAGEMENT AND (2–0–0)
APD 11301/12301 ENERGY RESOURCES (1–0–0)

MS: Disaster Management (2-0-0)

Concepts of disaster, types of disaster and dimensions of natural and anthropogenic disasters (cyclone, flood, land slide, subsidence, fire and earthquake); Principles and components of disaster management, Organizational structure for disaster management, Disaster management schemes; Introduction to natural disasters and mitigation efforts: Flood control, Drought management, Cyclones, Terror threats; Pre-disaster risk and vulnerability reduction, Post disaster recovery and rehabilitation, Disaster related infrastructure development; Role of financial institutions in mitigation effort; Psychological and social dimensions in disasters; Disaster management support requirements - training, public awareness

AP: Energy Resources (1-0-0)

Classification of energy resources and their availability; Renewable and non-renewable energy sources; World energy prospects; Environmental impacts; Energy, power and electricity; Energy scenario in India: Availability of conventional and nonconventional energy resources and future energy demand; Indian reserves and resources of natural oil and gas, coal and nuclear minerals; Potential of hydroelectric power, solar energy, thermal, nuclear, wind, tidal wave and biomass based power in India; Introduction to hydrogen energy and fuel cells

Reference Books:

1. Non-Conventional Energy Sources by G.D.Rai, Khanna Publishers.
2. Fundamentals of Renewable Energy Resources by G.N. Tiwari & M.K. Ghosal, Alpha Science International.
3. Solar Energy: Fundamentals and Applications by H P Garg & J Prakash, Tata McGraw-Hill Publishing Company Ltd.
4. Solar Energy: Principles of Thermal Collection and Storage by S P Sukhatme, Tata McGraw-Hill Publishing Company Ltd.

CSC 11301/12301 COMPUTER PROGRAMMING (3–0–0)

Introduction to Computer Software. Introduction to Programming, Data Types, Variables, Operator and Expressions, Assignments, Input/Output, Control statements and iterations, Arrays and subscripted variables, String Manipulation, Functions, Recursions, Structures and unions, Pointers, Dynamic memory allocation, Linked Structure, File Handling, Language Preprocessor and Command line arguments. Introduction to Object Oriented programming in C++.

HSC 11301/12301 VALUE EDUCATION, HUMAN RIGHT AND LEGISLATIVE PROCEDURE (3–0–0)

Social Values and Individual Attitudes, Work Ethic, Indians Vision of Humanism, Moral and Non-moral Valuation, Standards and Principles, Value Judgments. Rural Development in India, Co-operative Movement and Rural Development. Human Rights, UN declaration, Role of various agencies in protection and promotion of Rights. Indian Constitution, Philosophy of Constitution, Fundamental Rights and Fundamental Duties, Legislature, Executive and Judiciary: Their Composition, Scope and Activities. The Legislature: Function of Parliament, Constitution of Parliament, Composition of the Council of States, Composition of the House of the People, Speaker.

Legislative Procedure: Ordinary Bills, Money Bills, Private Members Bills; Drafting Bills; Moving the Bills, Debate, Voting, Approval of the President/ Governor. Vigilance: Lokpal and Functionaries.

PRACTICALS:

APC 11201/
APC 12201 **PHYSICS** **(0–0–3/2)**

1. Experiments on Semi-conductors-Measurement of band gap.
2. Experiments on Semi-conductors-Measurement of Hall Effect.
3. Measurement of thermal conductivity of bad conductors.
4. Optical experiments on Diffraction using diffraction grating.
5. Experiments using He-Ne Laser-Diffraction: Experiments to measure diameter of circular aperture; Polarization experiments to measure. Brewster's angle & refractive index.

ACC 11201/
ACC 12201 **CHEMISTRY** **(0–0–3/2)**

1. Standards of HCl by Standard Sodium Carbonate solution.
2. Determination of Temporary Hardness of Tap Water.
3. Estimation of Total Hardness of water.
4. Determination of Iron in Ferrous Ammonium Sulphate solution (Redox titration).
5. Determination of Copper in crystallized Copper Sulphate.
6. Estimation of available Chlorine in Bleaching Powder.
7. Determination of Molecular Weight of Organic Acid by Titration method.
8. Estimation of Sodium Carbonate and bicarbonate in a mixture.
9. To determine the saponification number of an oil.
10. To determine the rate of hydrolysis of methyl/ ethyl acetate.
11. To prepare Chrome Alum.

EEC 11201/ **(0–0–3/2)**
EEC 12201 **ELECTRICAL TECHNOLOGY**

Experiments on Thevenin's L-C Series circuit, Single theorem, phase power measurement, R Characteristics of fluorescent lamp and incandescent lamp, OC and SC tests of single phase transformer, Open-circuit characteristics of DC separately excited generator, external characteristics of separately excited DC generator, 3 point starter of DC shunt motor, Speed control of DC motor.

ECE 11201/
ECE 12201 **ELECTRONICS ENGINEERING** **(0-0-3/2)**

1. Study of Electronic Equipment & Components.
2. Study of diode characteristics.
3. Study of regulated power supply.
4. Study of BJT characteristics.
5. Study of op-amp characteristics.
6. Implementation of Boolean algebra using Logic gates.
7. Adder Circuits.
8. Flip Flops.

SEMESTER-III

APC13101/APM15101 WAVES AND ACOUSTICS (3-1-0)/ (3-0-0)

Critical review on Oscillations: Lissajous' figures; Small oscillations, linear and transverse oscillations of a mass between two springs; Two dimensional oscillator, Normal modes, Longitudinal and transverse oscillations of coupled masses, Energy transfer between modes, Coupled pendulum; Damped and forced oscillations, Amplitude and velocity resonances, Quality factor.

Waves: Wave motion; Wave velocity, Boundary conditions and normal modes, Dispersion relations, Dispersive waves, Acoustic and optical modes. Waves in continuous media, Waves in absorptive media; Energy density and energy transmission in waves, Normal and anomalous dispersions in waves, Group velocity and phase velocity; Bandwidth theorem. Superposition of waves: Linear homogeneous equations and the superposition principle, Interference in space and energy distribution; beats and combination tones, Fog-signalling and Zones of silence; Ultrasonics: Production, detection, properties and applications of ultrasonic waves; Acoustic grating.

Acoustics: Reflection and transmission of sound wave at a boundary between two media; Acoustic filters; Modulation and demodulation; Radio transmitter; Architectural acoustics: Reverberation, Sabine's and Eyring's formula, Absorption of sound, Acoustical designs of rooms and auditorium, Presence of echoes, Focussing of sound, Echelon effect, Noise reduction and sound insulations; Acoustical measurements, Recording of sound on disc and film and its reproduction, Musical sound and scale; Helmholtz's theory of consonance and disonance; Tracking of artificial satellites; Shock waves, propagation of explosive sound, seismic waves.

Textbooks:

1. Oscillations, Waves and Acoustics: by Mittal; I. K. International, 2010
2. Acoustics, Waves and Oscillations: By S. N. Sen; New Age International, 1990

Reference Books:

1. The Physics of Waves and Oscillations; Bajaj N K; Tata Mcgraw Hill; 2000
2. Waves and Oscillations; N Subrahmanyam; Vikas Publication House Pvt Ltd; 1994
3. Waves and Oscillations; B K Mukherjee; Campus Books International; 2009
4. Oscillations and Waves; Satya Prakash; Pragati Prakashan; 2010
5. Waves and Oscillations: By R. N. Chaudhuri; New Age International, 2010
6. A Text Book on Oscillations, Waves and Acoustics: By M. Ghosh and D. Bhattacharya; S. Chand Publisher, 2006

EIC 13103 SIGNALS AND NETWORKS (3-1-0)

Definitions and concepts of different types of signals and systems, Convolution, Differential and Difference equation, LTI systems, Fourier Series, Fourier Transforms, Laplace Transform and Z-transforms.

Graph Theory and Network Equations: Introduction, Incidence Matrix, Loop Matrix and the Cut Set Matrix, Interrelation among Various Matrices.Mesh Equations, Node Equations, Network with Mutual Inductance.
Two Port Networks: Short Circuit Admittances, Open Circuit Impedances, Hybrid Parameters, Chain Parameters, Inverse Transmission Parameters, and Interrelation between Parameters. Transient response in Circuit Analysis.

Reference Books:

1. Signals and Linear Systems: Gabel R.A. and Robert R.A; John Wiley and Sons, New York.
2. Signals and Systems: Oppenheim, Wilsky and Nawab; Prentice Hall, New Delhi.

3. Probabilistic Methods of Signals and System Analysis: Cooper G.R and McGillem C.D; 3rd Edition, Oxford University Press, Cambridge.
4. Network Analysis: Van Valkenburg; 3rd Edition, Prentice Hall, New Delhi.

MMC13102 ENGINEERING THERMODYNAMICS (3-1-0)

Basic Thermodynamics:
Introduction, thermodynamic system, control volume, properties, processes and cycles, thermodynamic equilibrium, concept of continuum, Quasi-static process; Zeroth law of thermodynamics, Work and heat transfer, First Law of Thermodynamics for a closed systems, Steady flow energy equation; Second Law of Thermodynamics: Kelvin-Planck and Clausius statements; Causes of irreversibility; Carnot's theorem; Absolute temperature scale; Inequality of Clausius; Entropy principle; Entropy transfer and entropy generation; Quality of energy; Energy principle; Guoy-Stodale theorem; Properties of a pure substance; p-v, p-T, T-s and h-s diagrams

Applied Thermodynamics:
Steam generators: Classification, construction, mountings, accessories, its functions and performance; Air standard cycles; Otto, Diesel, Dual, Stirling and Ericsson cycles; Vapour power cycles, Rankine cycle; Reheat and regenerative cycles; Vapour compression Refrigeration cycle and Gas turbine cycle. Principle of working of 2-S and 4-S internal combustion engines.

Reference Books:
1. Engineering Thermodynamics: P. K. Nag, Tata McGraw Hill
2. Thermodynamics: An Engg. Approach: Y.A. Cengela & M. A. Boles; Tata McGraw Hill
3. Engineering Thermodynamics: Van Wylen
4. Fundamental of Thermodynamics: Sonntag, Borgnakke and Van Wylen; John Wiley & Sons.
5. A textbook of Engg. Thermodynamics: R.K. Rajput; Luxmi Publications
6. Fundamentals of Engg. Thermodynamics: E. Ratankrishnan; Prentice-Hall of India.
7. Engineering Thermodynamics: C P Arora; Tata McGraw Hill.
8. A course in Internal Combustion Engines: M. L. Mathur & R. P. Sharma; Dhanpati Rai

AMR 13101 METHODS OF APPLIED MATHEMATICS-I (3-1-0)

Part – I
Complex Variables: Limit, continuity and differentiability of function of complex variables. Analytic functions. Cauchy-Riemann's equations, Cauchy's integral theorem, Morera's theorem, Cauchy's integral formula, Taylor's and Laurent's series, singularities, Residue theorem, contour integration.
Special Functions: Solution of Bessel equation, recurrence relations and generating function for Jn (x) orthogonal property and integral representation of Jn (x). Solution for Legendre equation, Legendre polynomial, Rodrigue's formula, orthogonality property and generating function for Pn(x).
Part – II
Laplace Transform: Laplace transform of simple functions, properties of Laplace transform, t-multiplication and t-division theorems, Laplace Transform of derivatives, integrals and periodic functions. Inverse Laplace transform and its properties, convolution theorem. Use of Laplace transform in evaluating complicated and improper integrals and solution of ordinary differential equations related to engineering problems.
Partial Differential Equations: Classification of partial differential equations, solutions of one dimensional wave equation, one dimensional unsteady heat flow equation and two dimensional steady heat flow equation by variable separable method with reference to Fourier trigonometric series.

Textbooks:
1. Advanced Engineering Mathematics by R.K. Jain and S.R.K. Iyenger.
2. Higher Engineering Mathematics by B.S. Grewal.

Reference Books:
1. Complex Variables (Schaum's Series) by Speigel.
2. Laplace Trasforms (Schaum's Series) by M.R. Speigel
3. Special Functions for Scientsts & Engineers by W.W. Bell

CSR 13101 DATA STRUCTURE (3-0-0)

Data structure overview, Data types, Creation and analysis of programs, Algorithm analysis; Different data structures: Arrays, Stacks, Queues, Circular queues, Priority queues, Linked lists together with algorithms for their implementation and uses; Sorting algorithms: Insertion, Selection, Bubble, Quick, Merge, Heap etc; **Searching algorithms:** Linear searching, Binary searching, Hashing strategy, Hashing functions and hash search;
Trees: Binary tree representation, Traversal, binary search tree, AVL trees, balancing rotations, Applications: Graphs: Representation, traversals, Shortest-path problems, Applications; Recursive: Divide-and-conquer, tower of Hanoi, etc.

Reference Books:
1. An Introduction to Data Structures with Applications, by Jean-Paul Tremblay, Paul G. Sorenson (TMH)
2. Theory and Problems of Data Structures, by Seymour Lipschutz (SCHAUM'S OUTLINE SERIES)
3. Data Structures using C and C++, by Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum (PHI)
4. Classic Data Structures, by D. Samanta (PHI)
5. Fundamentals of Data Structures in C++, by Ellis Horowitz, Sartaj Sahni, Dinesh Mehta (GALGOTIA)

APC13201 PHYSICS LAB-I (0-0-3)

Experiments based on:
Calculation of acceleration due to gravity, Study of resonance in forced vibrations, Determination of damping constant of damped oscillator, Determination of wavelength of stationary wave and velocity of sound in air, Determination of Young's modulus of steel wire, Determination of modulus of rigidity of hollow and solid metallic rods, Determination of coefficient of viscosity of liquid, Determination of coefficient of static and dynamic friction between wooden block and wooden surface, Charging and discharging of a Capacitor.

Textbooks:
1. An Advanced Course in Practical Physics by D. Chattopadhyay, P. C. Rakshit; New Central Book Agency (P) Ltd., 2007 (8e)
2. A Textbook of Advanced Practical Physics by S. K. Ghosh; New Central, 2000 (4e)

Reference Books:
1. Advanced practical physics for students, by B. L. Worsnop and H. T. Flint; Littlehampton Book Services Ltd., 1951 (9e)
2. Advanced Practical Physics, V-I & II by Chauhan and Singh; Pragati Prakashan
3. Physical Methods, Instruments and Measurements, Vol. 1-4, Edited by Yuri M. Tsipenyuk; Russian Academy of Sciences, Russia
4. Handbook of Physical Measurements, by Judith Hall, Judith Allanson, Karen Gripp, Anne Slavotinek; Oxford, 2e (2006)

5. Encyclopedia of Physical Science and Technology: Measurements Techniques and Instrumentation, by Robert Allen Meyers; Academic Press (2007)

MMC 13202 ENGINEERING THERMODYNAMICS LAB (0-0-2/2)

1. To study construction and operation of 2-stroke SI engine model.
2. To study construction and operation of 4-stroke SI engine model.
3. To study construction and operation of 4-stroke CI engine model.
4. To study construction and operation of various boiler models.
5. Performance testing of a 4-stroke Diesel engine.
6. Performance testing of a 4-stroke Petrol engine.
7. Performance testing of a steam boiler.
8. Performance testing of a steam power plant cycle.

SEMESTER-IV

APC14101/APM16101 CLASSICAL MECHANICS (3-1-0)/ (3-0-0)

Motion under central force: Equivalent one body problem, Differential equation of an orbit, Kepler's law, Center of mass and laboratory coordinates, Scattering in center of mass and laboratory frames, Scattering cross-section, Rutherford scattering, Elastic and inelastic collisions.
Motion in a non-inertial frame: Motion of a point particle in a general (rigid) non-inertial frame of reference, centripetal acceleration, Pseudo force, Coriolis force and its applications, Galilean Relativity.
Rigid body dynamics: Degrees of freedom of a rigid body, Moment of inertia and their products, principal moments and axes, Orthogonal transformations, Euler angles, Euler's equations, Precessional motion, heavy symmetrical top.
Lagrangian Formulation: Constraints and generalized Coordinates, degrees of freedom, D'Alembert's principle, Lagrange's equations from D'Alembert's principle, Hamilton's principle, Calculus of Variation and Lagrange's equations from Hamilton's principle. Conservation Theorems and Symmetry Properties, Simple applications of the Lagrangian formulation.
Hamiltonian Formulation: Definition of Hamiltonian, Legendre transformations, Hamilton equations and its application to simple cases, cyclic coordinates and conservation theorems, Canonical transformations, Poisson theorem, Poisson brackets.
Special theory of relativity: Minkowski world and Lorentz transformations, world lines, Relativistic Mechanics of Mass Points, Lorentz covariance of the new conservation laws, Relativistic analytical mechanics, Relativistic force.

Textbooks:
1. Classical Mechanics; Goldstein, Safko & Poole; Pearson; 2002
2. Classical Mechanics; Rana & Joag; Tata Mcgraw Hill; 1991
3. Classical Mechanics of Particles and Rigid Bodies; Gupta; John Wiley & Sons; 1988
4. Classical Mechanics; Systems of Particles & Hamiltonian Dynamics; Greiner; Springer-Verlag; 2009

Reference Books:
1. The General Properties of Matter; Newman and Searle; Edward Arnold; 1961
2. Elements of Properties of Matter; D.S. Mathur; S. Chand & Co. Ltd; 2010
3. Mechanics and General Properties of Matter; P.K. Chakraborti, Kolkata Books and Allied; 2009
4. Classical Mechanics; J. C. Upadhyay; Himalaya Publication House; 2008.

APC14102/APM16102 Mathematical Physics (3-1-0)/(3-0-0)

Beta, Gamma and Error functions: Symmetry properties, evaluation and transformation, relation between above functions, evaluation of miscellaneous integrals.
Differential Equations and Special Functions: Second order linear ODEs with variable coefficients; Solution by series expansion; Legendre, Bessel, Hermite and Laguerre equations and their solutions; Physical applications; Generating functions; recurrence relation; Green's function and its applications.
Fourier transform: Sine, Cosine and complex transforms with examples, definition, properties and representations of dirac delta function, properties of Fourier transforms, transforms of derivatives, Parseval's theorem, Convolution theorem, Momentum representation, Application of Fourier transformation to partial differential equations, discrete Fourier transforms, introduction to Fast Fourier Transforms.
Group theory: Concept of group, examples of group, abelian group, generators of finite group, cyclic group, group multiplication table, subgroup, conjugate elements and classes, isomorphism and homomorphism.
Tensors: Transformation properties, Metric tensor, Raising and lowering of indices, Contraction, Symmetric and anti-symmetric tensors, Christofell's symbols, transformation laws.

Textbooks:
1. Mathematical Methods for Physicists; Arfken & Weber; Academic Press; 2010
2. Introduction To Mathematical Physics; Harper; PHI Learning; 2009
3. Mathematical Physics; B.D. Gupta, Vikas Publishing House, 1986
4. Mathematical Physics; Advanced Topics; Joglekar; Universities Press; 2006

Reference Books:
1. Mathematical Methods in Physical Sciences; Boas; Wiley India Pvt Ltd; 2006
2. Mathematical Physics; Satya Prakash, S. Chand and Sons 1992.

APC14103/APM16103 APPLIED OPTICS (3-1-0)/(3-0-0)

Geometrical Optics: Fermat's principle, General Theory of Image formation, The Matrix Method in paraxial optics.
Physical Optics: Interference of light: The principle of superposition, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Localised fringes; thin films. Diffraction: Fresnel diffraction: Fresnel half-period zone plates, straight edge, rectilinear propagation; Fraunhoffer diffraction: Diffraction at a slit, half-period zones, phasor diagram and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, Rayleigh criterion, Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, Resolving power of a grating. Double refraction and optical rotation: Refraction in uniaxial crystals, its electromagnetic theory. Phase retardation plates, double image prism, polarization and transfer function, Rotation of plane of polarization, origin of optical rotation in liquids and in crystals.
Applications: Rayleigh refractometer, Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Intensity distribution in multiple beam interference, Fabry-Perot interferometer and etalon.
Optical systems: Characteristics of objectives, eyepieces, condensers for different applications. Human eye. Image manipulation by prism systems.

Textbooks:
1. Fundamental of Optics: Jenkins and White; McGraw-Hill; 2001
2. Optics: Ajoy Ghatak; Tata McGraw-Hill;2005

3. Optics: Eugene Hecht; Addison-Wesley;, 2001
4. Principles of Optics; M. Born and E. Wolf; Cambridge University Press; 1999

Reference Books:

1. Geometrical and Physical Optics: P. K. Chakrabarti; New Central Book Agency; 2010
2. Applied Optics and Optical Design; A.E Conrady; Dover Publications; 2011
3. Introduction to Applied Optics; Banerjee and Poon; CRC Press; 1991
4. Optics and Optical Instruments; Johnson; Dover Publications; 2011
5. Modern Optical Engineering, Warren Smith, McGraw-Hill Professional; 2007
6. Optics: Brij Lal and Subrahmanyam , S. Chand; 2010

AMR 14101 NUMERICAL AND STATISTICAL METHODS (3-1-0)

Part – I

Numerical Methods: Solution of algebraic and transcendental equation by bisection, iteration, false position and Newton-Raphson methods.

Solution of a system of linear simultaneous equations by Gauss elimination, Gauss-Jordan, Crout's triangularisation, Jacobi and Gauss-Seidel methods.

Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton-Gregory forward and backward, Gauss forward and backward, Stirling, Bessel and Lagrange's formulae, Inverse interpolation by Lagrange and iterative methods, Numerical differentiation and integration: Trapezoidal, Simpson's 1/3rd, Simpson's 3/8th and Weddle quadrature formulae.

Numerical solution of first order ordinary differential equations by Taylor's series, Picard's, Euler's, Modified Euler's, Runge-Kutta and Milne's methods. Solution of simultaneous first order and second order ordinary differential equations with initial conditions by Runge-Kutta and Milne's methods. Numerical solution of boundary value problems by finite difference method.

Part – II

Statistical Methods: Moments, skew ness and kurtosis.

Probability: Various approaches of probability, two theorems (without proof), conditional probability, Bayes theorem.

Random variable: Definition, probability mass & density functions, distribution function, mathematical expectation and moment generating function.

Probability distributions: Bernoulli, binomial, Poisson and normal distributions.

Theory of least squares and curve fitting.

Correlation and Regression: Simple, multiple & partial correlation coefficients, regression lines, regression coefficients and their properties.

Test of significance: Normal test, t-test, chi square test and F test.

Textbooks:

1. Higher Engineering Mathematics by B.S. Grewal.
2. Fundamentals of Mathematical Statistics by S.C. Gupta and V.K. Kapoor.

Reference Books:

1. Fundamentals of Statistics Vol I by A.M. Goon, M.K. Gupta, B. Dasgupta.
2. Elementary Statistics by H.C. Saxena.
3. Miller & Freund's Probability and Satistics for Engineers by Rachard and Jhonson.
4. Introductory Methods of Numerical Analysis by S.S. Sastry.
5. Numerical Methods in Engineering and Science by B.S. Grewal.

EER 14101 APPLIED ELECTRICAL ENGINEERING (3-0-0)

Operation and characteristics of three-phase Induction motors; Methods of starting & speed control of three phase induction motor; Ward-Leoard method of speed control of DC motor; Basic principles of Thyristor controlled variable speed DC and AC motors.

Principles of rate making of electricity and power factor improvement; Substation arrangement; Circuit breakers; Protective relays: - Induction pattern over current relay, thermal overload relay, earth fault relay, Lightning Arrester, Fuses: - types and selection.

Power cables: - Types & selection, Types of motor enclosure, FLP enclosures for hazardous area equipment, Intrinsically safe circuit.

Industrial application & control of electrical motors: - Types of electric motors and their application in Industry; Controller for the speed control of DC & AC motors.

Diesel – Electrical oil rigs. I.E rules applied to mines & oil fields.

Textbooks:

1. Electrical Power Systems: A Husain; Cbs Publishers & Distributors.
2. Electrical Machines: P K Mukherjee & S Chakraborty; Dhanpat Rai Publications (p) Ltd.
3. Fundamentals of Electrical Drives: G. K. Dubey, CRC Press, 2002.
4. A Text Book on Power System Engineering: Soni, Gupta, Bhatnagar, Chakrabarti; Dhanpat Rai and Company Private Limited.

APC14201 PHYSICS LAB-II (0-0-3)

Experiments based on:

Photo-elastic effects and determination of photo-elastic constant of perspex glass; Dynamic light scattering; Determination of specific rotation of sugar; Determination of wavelength of sodium light (such as Newton's ring experiment, Fresnel's bi-prism); Determination of refractive index using hollow prism and liquid prism; Identification of missing order in double slit diffraction pattern; Determination of thickness and refractive index of glass plate; Fabry-Perot interferometer (determination of spectral line separation, wavelength and distance between mirrors); Study of monochromatic aberrations of optical system.

APC14202 PHYSICS LAB-III (0-0-3)

Experiments based on:

Determination of Planck's constant; Determination of e/m ratio of electron ; Plot of B-H loop of ferromagnetic material and calculation of hysteresis loss; Determination of magneto-resistance of semiconductor; Determination of band gap; Determination of bending moment of cantilever; Measurement of contact angles of water and organic liquids on Teflon and glass substrates; Determination of velocity of transverse waves in stretched strings; Determination of velocity of sound in air at room temperature by study of resonances in organ pipes.

SEMESTER-V

APC15101/APM15102 QUANTUM MECHANICS (3-0-0)/ (3-0-0)

Introduction: Wave-particle duality, notion of state vector and its probability interpretation;

Structure of Quantum Mechanics: Operators and observables, significance of eigenfunctions and eigenvalues, commutation relations, uncertainty principle, measurement in quantum theory.

Schrödinger Equation: Time-dependent Schrödinger equation, stationary states and their significance, time-independent Schrödinger equation;

Potential Problems: Free-particle solution, Potential Barrier and tunneling, simple harmonic oscillator,

Motion in a central potential: Separation of variables in spherical polar coordinates, spherical harmonics, free particle in spherical polar coordinates, hydrogen atom problem.
Representation Theory: Linear vector space, Dirac notations of Bra - Ket, Matrix representation of Observables and states, operators and their properties; unitary transformation, Parity and parity operators
Theory of Angular Momentum: Relation between rotation and angular momentum, Rotation operators, angular momentum algebra: commutation rules, Matrix representations, addition of angular momenta, spinors and Pauli spin matrices.
Approximation Methods: Time-independent Perturbation theory: (non-degenerate and degenerate) and applications to fine structure splitting, WKB approximation; Variational method; Time-dependent perturbation theory, transition probability calculations, Fermi golden rule.
Scattering Theory: Introduction, partial wave analysis, Born approximation.

Textbooks:
1. Introduction of Quantum Mechanics; Griffiths; Pearson Education; 2010
2. Quantum Mechanics; Thankappan; New Age International Pub; 1993
3. Quantum Mechanics, 3rd Edition; Merzbacher; John Wiley; 2005

Reference Books:
1. Principles of Quantum Mechanics; R. Shankar, Plenum Press; 1994
2. Modern Quantum Mechanics; Sakurai; Pearson; 1994
3. Quantum Mechanics 2nd Edition; Bransden & Joachain; Pearson; 2000
4. Introduction to Quantum Mechanics; Pauling and Wilson; Dover Publications 1985
5. Quantum Mechanics: Theory and Applications, 1e; Ghatak & Lokanathan; Kluwer Academic Publishers; 2004

APC15102 ANALOG AND DIGITAL ELECTRONICS (3-0-0)

Analog: Introduction to diodes and transistor, rectifier; BJT/FET amplifiers; Feedback: effect of negative and positive feedback, basic feedback topologies; Feedback amplifiers: sinusoidal oscillators. Different classes of power amplifiers;
differential amplifiers; Operational amplifiers: integrators, differentiator, arithmetic circuits, active filters, voltage controlled oscillators, A/D and D/A converters, sample and hold circuits and other applications of Op-amps; 555 timer IC, multivibrators.

Digital: Number systems; Transistor as a switch; Logic gates; Boolean Algebra, De Morgan's laws; Karnaugh map; Arithmetic circuits; RS, JK, JK Master-Slave, T, D Flip-Flops; Registers; Synchronous, Asynchronous and Cascade Counters; Comparators; A/D and D/A conversion; Multiplexer, Demultiplexer; Basics of Microprocessors and Microcontrollers.

Textbooks:
1. Electronic Devices and Circuit Theory, Robert L. Boylestad & L. Nashelsky, Pearson, 2013
2. Electronic Devices and Circuits (SIE); Cathey; Mcgraw-Hill Education (India) Ltd; 2008
3. Foundations of Analog and Digital Electronic Circuits, A. Agarwal & J. Lang, Elsevier, 2005.
4. Basic Digital Electronics, J.A. Strong, Springer, 1991.
5. Digital Logic Design, B. Holdsworth & R.C. Woods, Elsevier, 2003.
6. Digital Principles and Applications; Leech & Malvino; Tata Mcgraw Hill; 2006
7. Introduction to Microprocessors and Microcontrollers, John Crisp, Elsevier, 2004
8. Understanding 8085/8086 Microprocessors and Peripheral ICs, S. K. Sen, New Age International, 2010

Reference Books:

1. Millman's Electronic Devices and Circuits; Millman; Tata Mcgraw Hill; 2007
2. Microelectronic circuits, A. S. Sedra & K.C. Smith, Oxford University Press, 2008
3. Op Amps and Linear Integrated Circuits, R. K. Gaykwad; Prentice-Hall of India, 2002
4. Electronic Devices and Circuits; Gupta; S.K. Kataria & Sons; 2010
5. Digital Fundamentals; Thomas L Floyd; Pearson Education Limited;
6. Electronic Fundamentals & Applications: Int. & Discrete Systems; Ryder; PHI Learning; 2009
7. Electronics; Fundamentals & Applications; Chattopadhyay & Rakshit; New Age; 2010
8. Microprocessor Architecture, Programming, and Applications with the 8085; Ramesh Gaonkar; CBS Publishers; 2011
9. Microprocessors and Microcontrollers; A. Nagoor Kani; Tata-Mcgraw Hill; 2012

APC15103/APM15103 ELECTRODYNAMICS (3-0-0)/ (3-0-0)

Electrostatics: Differential form of electrostatic field equation, Poisson and Laplace equations, formal solution for potential with Green's functions, Dirichlet and Neumann boundary conditions, boundary value problems, examples of image method and Green's function method, solutions of Laplace equation in cylindrical and spherical coordinates by orthogonal functions, dielectrics, polarization of a medium, electrostatic energy, Multipole Expansion.

Magnetostatics: Biot-Savart law, Ampère's law, differential equation for static magnetic field, vector potential, magnetic field from localized current distributions, examples of magnetostatic problems, Faraday's law of induction, magnetic energy of steady current distributions.

Maxwell's Equations: Displacement current, Maxwell's equations, vector and scalar potentials, gauge symmetry, Coulomb and Lorentz gauges, electromagnetic energy and momentum, conservation laws, inhomogeneous wave equation and Green's function solution. Plane waves in a dielectric medium, reflection and refraction at dielectric interfaces, frequency dispersion in dielectrics and metals, dielectric constant and anomalous dispersion, wave propagation in one dimension, group velocity, metallic wave guides, boundary conditions at metallic surfaces, propagation modes in wave guides, resonant modes in cavities.

Radiation: Field of a localized oscillating source, fields and radiation in dipole and quadrupole approximations, radiation by moving charges, Lienard-Wiechert potentials.

Textbooks:

1. Classical Electrodynamics; Jackson; John Wiley; 2007
2. Classical Electricity and Magnetism; Panofsky and Phillips; Dover Publications, Inc.; 1990
3. Classical Electrodynamics; Greiner; Springer; 1998
4. Introduction to Electrodynamics; Griffiths; PHI Learning; 2009

Reference Books:

1. Electricity & Magnetism; Chattopadhyay & Rakshit; New Central Book Agency; 2005
2. Feynman Lectures, Vol-II; Feynman, Leighton & Sands; Narosa Publishing House; 1998
3. Fundamentals of Magnetism and Electricity; Vasudeva; S. Chand Publisher; 2004
4. Foundations of electromagnetic theory; Reitz, Milford & Christy; Pearson; 2009.
5. Electrodynamics; Gupta, Kumar & Sharma; Pragati Prakashan; 2010
6. Classical Electromagnetic Theory; Vanderlinde; John Wiley & Sons; 1993

MSC15152 INDUSTRIAL ENGINEERING AND MANAGEMENT (3-0-0)

Basic functions of management – planning, organizing, staffing, directing and controlling.
Introduction to industrial Engineering techniques.
Productivity: definition, measurement.
Work study and its role in improving productivity of an organization.
Types of Production systems.
Introduction to production planning and control.
Concepts of human resource management – selection, training and development.
Finance management – capital budgeting techniques, payback period, ARR, NPV, IRR, PI; Sources of capital; Costs concepts and Break even analysis.
Project management – Introduction, Network construction & identification of critical activities in CPM & PERT.

Reference Books:
1. Essentials of Management, Koontz a andO'Donne.
2. Finance Sense, Prasanna Chandra
3. Industrial Management, M E ThukaramRao.
4. Work Study, I.L.O.
5. A Management Guide to PERT/CPM, J D Wiest and F K Levy.

APC15201 PHYSICS LAB-IV (0-0-3)

Experiments based on:
Verification of Wien's displacement law; Verification of Stefan-Boltzmann law of thermal radiation; Study of Seebeck effect; Design of RC filter circuit and calculation of phase factor and time constant; Study of single stage and cascade amplifier in CE and CB configuration; Phase shift oscillator circuit design, current voltage characteristics and Q-factor; Plot static characteristics of JFET and MOSFET and determine the transistor parameters; Operational amplifier for mathematical operations (differentiator and integrator); Multivibrator (555 timer).

SEMESTER-VI

APC16101/APM18101 NUCLEAR SCIENCE AND ENGINEERING (3-0-0)/ (3-0-0)

Basics of nucleus and its stability: Masses, sizes, spins, angular momentum, magnetic moments, parity, quadrupole moments, energetic and stability against particle emission, Gamow's theory of Alpha decay, Fermi theory of Beta decay, Gamma decay, Internal conversion, Nuclear isomerism.
Two Nucleon Problem: Nature of nuclear forces, Meson theory of nuclear forces, Deuteron problem, Nucleon-Nucleon scattering, scattering length, coherent and incoherent scattering, Effective range theory.
Nuclear model: Liquid drop model, Shell model, Semi-empirical mass formula
Detectors & Accelerators: Gas-Filled Ionization Detectors, Proportional counter, G.M. counter, Semiconductor Detectors, Solid State Scintillation Counters, Synchrotrons, Linear Accelerators, Colliding/Beam Accelerators.
Nuclear Reactions: Conservation laws, Classification, Compound Nucleus theory, Continuum and Statistical theories, Cross-sections, Breit-Wigner formula, Direct Reactions.
Elementary particles: Leptons, Mesons and Baryons, concept of antiparticle, discrete symmetries and conservation laws, Weak interactions (nuclear and particle decays, neutrinos etc.). Isospin and strangeness, Gellmann-Nishijima formula, quark model, color, resonances.

Nuclear reactors: Nuclear fission, critical size of reactor, general aspect of reactor design, classification of reactors, neutron moderation, Fissile and fissionable material, neutron economy, homogeneous reactor examples, infinite and finite reactor, operation and control, accidents, fast breeders, hybrid reactors. Fusion: Basic reactions and energetic, Lawson's criteria for fusion, Stellar fusion, nucleogenesis, controlled fusion- plasma confinement, laser implosion.
Application of nuclear techniques: Dating techniques, Radiation therapy, Particle therapy.

Textbooks:
1. Atomic & Nuclear Physics; Vol.2; S. N. Ghoshal; S. Chand; 1994
2. Fundamentals of Nuclear Physics; Verma, Bhandari and Somayajulu; CBS Publisher; 2010
3. Nuclear Physics; D. C. Tayal; Himalaya Publishing House; 2013
4. Introductory Nuclear Physics; Wong; Prentice Hall of India; 2010
5. Nuclear and Particle Physics; Burcham and Jobes; John Wiley & Sons; 1995
6. Theory of Nuclear Structure; S.K.Gupta; Alfa Publication; 2011
7. Nuclear Physics: Theory and Experiments; Roy & Nigam; New Age International; 2014

Reference Books:
1. Introductory Nuclear Physics; Kenneth S. Krane; Wiley India Pvt Ltd; 2011
2. Nuclear Physics; I. Kaplan; Narosa; 2006
3. Quarks and Leptons; Halzen and Martin. Wiley India Pvt Ltd; 2008

APC16102/APM16104 ATOMIC AND MOLECULAR PHYSICS (3-0-0)/ (3-0-0)

Atomic spectra: Atomic orbital, Hydrogen spectrum-Pauli's principle, Spin orbit interaction and fine structure in alkali Spectra, Equivalent and non-equivalent electrons, Normal and anomalous Zeeman effect – Paschen Back effect, Stark effect-Two electron systems.
Atom model: Vector atom model, interaction energy in L-S and J-J Coupling, Hyperfine structure, Line broadening mechanisms, Doppler and Lorentz Broadening.
Molecular spectra: Rotational spectra of diatomic molecules as a rigid rotor and non rigid rotor, intensity of rotational lines, Frank-Condon principle. Vibrational and rotational spectra, Vibrational energy of diatomic molecule. Raman spectroscopy, Rotational Raman spectra of diatomic molecules.
Nuclear spectra: Mossbauer spectroscopy, Nuclear Magnetic Resonance and Magnetic Resonance Imaging.

Textbooks:
1. Introduction to Atomic Spectra; White; Mcgraw-Hill Education; 1934
2. Atomic Spectra And Atomic Structure; Herzberg; Dover; 2008
3. Physics of Atoms and Molecules; B.H. Bransden and C.J. Joachain, Addison-Wesley; 2003
4. Introduction to Molecular Spectroscopy; Barrow; Mcgraw-Hill Education; 1962

Reference Books
1. Fundamentals of Molecular Spectroscopy; Banwell; Mcgraw-Hill Education Ltd; 2000
2. Atomic & Molecular Spectra; Raj Kumar, Kedar Nath Ram Nath, New Delhi , 1997
3. Modern Spectroscopy; Hollas; Wiley India Pvt Ltd; 2010.

APC16103/APM16105 SOLID STATE PHYSICS (3-0-0)/ (3-0-0)

Crystallography: Crystal structure, fundamental translational vectors, unit cell, Wigner-Seitz cell, Symmetry elements, lattice types, lattice planes, Miller indices, Common crystal structures., Reciprocal lattice, Bragg's law and applications.
Bonding in crystals: Potential between a pair of atoms; Lennard-Jones potential, concept of cohesive energy, covalent, Van der Waals, Crystal Defects.
Thermal properties: Lattice vibrations, vibrations of one dimensional monoatomic and diatomic linear chain of atoms, concept of phonons, Debye model.
Free electron theory of metals: Drude-Lorentz theory, Sommerfield's Model, Fermi-Dirac Distribution, free electron concentration, electrical conductivity, Thermal Conductivity, Sommerfield theory of electrical conductivity.
Band structure: Electrons in periodic potential: Bloch theorem, Kronig-Penny Model, energy bands.
Dielectric properties: Static, electronic, ionic and orientational Polarization, Lorentz internal field, dielectric loss and relaxation time, Piezo, Pyro, Ferro electric properties and applications.
Magnetic Properties: Diamagnetic, Paramagnetic and Ferromagnetic Materials, Curie-Weiss law of susceptibility, Weiss Molecular field theory.

Textbooks:

1. Introduction to Solid State Physics; C. Kittle; Wiley; 2012
2. Crystallography Applied to Solid State Physics; Verma & Srivastava; New Age; 1991
3. Solid State Physics; A. J. Dekker; Macmillan; 2010
4. Solid State Physics; Ashcroft and Mermin; Cengage Learning India Pvt Ltd; 2010
5. Elements of X-Ray Diffraction, B. D. Cullity, Addison-Wesley Publishing Company, INC., MA, USA 1956
6. Solid State Physics (Introduction to the theory), J. Patterson, B. Bailey, Springer-Verlag Berlin Heidelberg, 2010
7. Principles of Electronic Materials And Devices, S. O. Kasap, McGraw Hill Company, INC., 2006

Reference Books:

1. Solid State Physics: Structure and Properties of Materials; M. A. Wahab; Narosa; 2009
2. Solid State Physics; S. O. Pillai; New Age International; 2010
3. Elements of Solid State Physics; J. P. Srivastava; Prentice Hall of India; 2013
4. Solid State Physics; R. L. Singhal; Kedar Nath Ram Nath; 1998
5. Fundamentals of Solid State Physics; Saxena, Gupta, Saxena; Pragati; 2012
6. Elementary Solid State Physics; Ali Omar; Pearson; 2010

EIC16103 DIGITAL SIGNAL PROCESSING (3-0-0)

Introduction: Sampling of Continuous-time signals: frequncy-domain representation of Sampling, reconstruction of bandlimited signal from its samples, discrete-time processing of continuous-time signals, Sampling rate changes- Upsampling and downsampling. Digital Filter Design: Design of IIR Filters (Analog approximations- Butterworth, Chebyshev and Transformations- Impulse Invariance and Bilinear Transformation), FIR filter design using Windowing and Frequency Sampling methods. Digital Filter Structures: Direct forms, Cascade and Parallel forms, Linear phase and Frequency sampling structures for

FIR systems Discrete Fourier Transform: Definition, Properties, Computation of DFTs, radix-2 FFT algorithms (Decimation-in-time and Decimation-in- frequncy), DFT based Spectral analysis. Finite Word Length Effects: Discrete-time Random signals, Quantization effects, Coefficient quantization, Round-off noise. Digital Signal Processors: Introduction to TMS-320 family of Digital Signal Processors Applications of DSP (e.g. Musical Signal Processing, Speech Processing) Introduction to Advanced Topics (Wavelets and Multiresolution analysis, Adaptive Signal Processing)

Reference books:

1. Discrete Time Signal Processing by A. V. Oppenheim, R. W. Shafer and J. R. Buck*, (Publisher-Pearson Education)*
2. Digital Signal Processing by J. G. Proakis and D. G. Manolakis, *(Publisher-Pearson Education.)*
3. Digital Signal Processing: A Computer based approach by S. K. Mitra *(Publisher- McGraw-Hill international)*
4. Digital Signal Processing by A. Nagoor Kani *(Publisher- Tata McGraw-Hill)*

SEMESTER-VII

APC17101/APM17101 STATISTICAL MECHANICS (3-0-0) / (3-0-0)

Ensemble Theory: Concept of Phase space, Liouville's theorem, Microcanonical ensemble, canonical and grand canonical ensembles; partition function, calculation of statistical quantities, Energy and density fluctuations; Meyer cluster expansion method for classical gas, virial quation of state.

Quantum Statistics: Density matrix, statistics of ensembles, statistics of indistinguishable particles; Maxwell-Boltzman, Fermi-Dirac and Bose Einstein statistics; properties of ideal Bose and Fermi gases, Bose-Einstein condensation. Application of Fermi-Dirac statistics to white dwarf stars and Chandrasekhar limit.

Phase transitions and critical phenomena: Ising model: mean-field theories of the ising model in one, two and three dimensions, Exact solutions in one dimension; Landau theory of phase transition, critical indices, scale transformation and dimensional analysis.

Non-equilibrium statistical mechanics: Correlation of space-time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, Langevin theory, fluctuation dissipation theorem. The Fokker-Planck equation.

Textbooks:

1. Statistical Mechanics: R. K. Pathria; Elsevier; 2002
2. Fundamentals of Statistical and Thermal Physics; Reif; McGraw-Hill; 1965
3. Thermodynamics and Statistical Mechanics; Greiner; Springer; 2007

Reference Books:

4. Statistical Mechanics: K Haung; Wiley Eastern; 2003
5. Modern Theory of Critical Phenomena: Shang Keng Ma; Levant Books; 2007
6. Statistical Mechanics: Landau and Lifshitz; Butterworth-Heinemann; 1976
7. Introduction to Phase Transitions and Critical Phenomena; H. Eugene Stanley; Oxford University Press; 1987

APC17102/APM17102 PHYSICS OF NANOMATERIALS (3-0-0)/ (3-0-0)

Introduction: Nanomaterials; Small-scale nonequilibrium systems; Phase transitions in nanocrystals; Geometric evolution of the lattice in nanocrystals; Nanothermodynamics, Solid–liquid transitions; Melting point of nanomaterials; Inverse systems: Nanoporous solids, Confined fluids, Phase diagram and Metastability; Graphene, Fullerenes and Carbon Nanotubes; Supramolecular structures; Nanocomposites.

Electronic structure: Band Structure, Density of States (DOS) in bands, Variation of DOS with energy, Variation of DOS and band gap with size of crystal; Dimensional dependence of DOS of Fermi gas electrons. Electron confinement in infinitely deep and finite square well potentials; Physical concepts of circular, parabolic and triangular well potentials.

Quantum size effect: Properties of nanoparticles, Characteristic lengths, Clusters, Magic Numbers; Quantum well, Quantum wire, Quantum dot; Energy subbands; Conduction electrons and dimensionality; Properties dependent on DOS. Electrical transport properties, Diffusive and ballistic regime, Single electron tunneling, Quantum structural properties in Superconductivity; Excitons, Optical absorption in quantum well; Surface plasmon resonance; Dynamics at the nanoscale; Nanomagnetism; Nanomechanical properties.

Overview of preparation methods: Classification, Top-down and Bottom-up approach, Overview of different fabrication and synthesis techniques such as Ball Milling, Chemical bath Deposition, Electrodeposition, Sol-Gel, Physical Vapor Deposition, Pulsed Laser Deposition, Molecular Beam Epitaxy.

Textbooks:

1. Introduction to Nanotechnology, Poole & Owners, Wiley India Pvt Ltd, 2007.
2. Nanotechnology: A Crash Course, Raul J. Martin-Palma, Akhlesh Lakhtakia, SPIE Publications, 2010.
3. Handbook of Nanophysics – Principles and Methods: By Klaus D. Sattler; CRC Press, 2010
4. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, Cao; World Scientific Publishing Company, 2011.
5. Introduction to Nanoscience and Nanotechnology, Chattopadhyay & Banerjee, PHI Learning Pvt. Ltd., 2009.
6. Nanoscience and Nanotechnology – Fundamentals to Frontiers: By M. S. Ramachandra Rao, S. Singh; Wiley, 2013.
7. Chemistry of Nanomaterials: Synthesis, Properties and Applications, Rao, Muller & Cheetham, Wiley VCH; 2004.

Reference Books:

1. Materials Science and Engineering: An Introduction, W. D. Callister, John Wiley & Sons, 2006.
2. Materials Science and Engineering, V. Raghvan, PHI Learning Pvt. Ltd., 2004.
3. Nanotechnology: A Crash Course, R. Raul J. Martin-Palma, Akhlesh Lakhtakia, SPIE Press, 2010.
4. Nanoscience and Nanotechnology in Engineering, V. K. Varadan, World Scientific, 2010.
5. Introduction to nanoscience and nanotechnology, Gábor Louis Hornyak, Harry F. Tibbals, Joydeep Dutta, CRC Press, 2009.
6. Quantum Dots, Jacak, Hawrylak & Wojs, Springe, 1998.
7. Nanotechnology: Principles and fundamentals, Günter Schmid, Wiley-Vch, 2008.
8. Nanomaterials and Nanochemistry: By C. Brchignac, P. Houdy and M. Lahmani; Springer, 2008.

APC17103/APM17103 THIN FILM TECHNOLOGY (3-0-0)/ (3-0-0)

Vacuum Generation:

Basic terms and concepts; Continuum and Kinetic gas theory; Pressure ranges; Types of flow; Conductance. Vacuum pumps – a survey; Principle of operation, Diaphragm pump, Rotary pump, Diffusion Pump, Turbomolecular Pump (TMP), Sputter-ion pumps; Cryogenic Pump.

Vacuum gauges: Thermal conductivity vacuum gauges, Ionization vacuum gauges.

Analysis of gas at low pressures: Residual gas analyzers, Quadrupole mass spectrometer. Leaks and their detection.

Thin Film Fabrication:

Nucleation and Growth: Film formation and structure; Thermodynamics of nucleation, Nucleation theories: Capillarity model – homogeneous and heterogeneous nucleations, Atomistic model – Walton-Rhodin theory; Post-nucleation growth; Deposition parameters; Epitaxy; Thin film structure; Structural defects and their incorporation.

Preparation methods: Electrochemical Deposition (ECD); Spin coating; Physical Vapor Deposition (PVD)- thermal evaporation, electron beam evaporation, rf-sputtering; Pulsed Laser deposition (PLD); Chemical Vapor Deposition (CVD), Plasma-Enhanced CVD (PECVD), Atomic Layer Deposition (ALD), Molecular Beam Epitaxy (MBE).

Thickness measurement and monitoring: Electrical, mechanical, optical interference, microbalance, quartz crystal methods.

Textbooks:

1. Thin Film Phenomena; Chopra; McGraw-Hill; 1969
2. Handbook of Thin Film Technology; Maissel & Glang; McGraw-Hill; 1970
3. Thin Film Fundamentals; Goswami; New Age International Pvt. Ltd; 2007
4. Vacuum Science and Technology, by Rao, Ghosh and Chopra; Allied Publishers, 1998

Reference Books:

1. Materials Science of Thin Films; Milton Ohring; Academic Press; 2001
2. Thin Films; Heavens; Dover Publications Inc.; 1991
3. Thin-Film Deposition: Principles and Practice; Smith; McGraw-Hill; 1995
4. Thin Film Processes I; Vossen & Kern; Elsevier Science & Technology Books; 1978
5. Thin film processes II; Vossen & Kern; Academic Press; 1991
6. Handbook of Vacuum Science and Technology, by Hoffman, Singh and Thomas; Academic Press; 1998
7. Vacuum Technology, by Roth; North Holland, 1990
8. Fundamentals of Vacuum Technology; Umrath; Leybold, 1998.

APC17104/APM17104 OPTICAL COMMUNICATION (3-0-0)/ (3-0-0)

Introduction: Introduction of optical fiber and fabrication, transmission characteristics of optical fiber- Maxwell's equations in homogeneous and inhomogeneous medium, solution for planner waveguide and Step Index Fiber, concept of TE, TM, hybrid and LP modes. Dispersion- concept of dispersion in fibers, intramodal, intermodal and overall dispersion, attenuation in fiber.

Optical sources: basic principles of LEDs and LDs, modulation characteristics and drive circuits.

Optical detectors: p-n, p-i-n, APD type detectors, principle of operation and performance characteristics, receivers performance, link power budget using direct detection. Fiber optic connectors, couplers and multiplexers. Optical amplifiers, Coherent Optical Communication and WDM Techniques.

Textbooks:

1. An Introduction to Fiber Optics; Ajoy Ghatak, K. Thyagarajan; Cambridge University Press; 1998.
2. Integrated optoelectronics: Waveguide optics, Photonics, Semiconductors, Karl J. Ebeling, Springer London; 2011
3. Optics, Eugene Hecht, Addison-Wesley, 2001.

Reference Books:

1. Optical waves in layered media, Pochi Yeh, Wiley, 2005.
2. Principles of Optics, Max Born & Emil Wolf, Cambridge University Press, 1999.

3. Physics of Optoelectronic Devices, Chuang, S. L., Wiley-Interscience, 1995.

SEMESTER-VIII

APC18101/APM18102 PHOTONICS AND OPTOELECTRONICS (3-0-0)/ (3-0-0)

Introduction to Photonics: Polarization of light waves, Dielectric polarization, Electromagnetic Waves and Interfaces I, Electromagnetic Waves and Interfaces II, Mirrors, Interferometers and Thin-Film Structures, Holographic interferometry, Integrated Optics: planar and 2D Waveguides, Coupled Mode Theory, Optical Resonators, Exciton, Semiconductor photon sources and detectors, Photonic Crystals, Photonic band gap on dimensionality, Plasmonic crystal, Plasmonic cavity, Negative refractive index, Metamaterials, Optical clocking,
Applications: Organic and polymeric light emitting diodes, Organic and inorganic solar cells, Quantum well photodetector, OLED lasers, Nanophotonic lasers- Photonic crystal laser, Plasmonic laser, SPASERs, Quantum cascade lasers, Photonic sensors, Plasmonic sensors, Photonic switching.

Textbooks:
1. Fundamentals of Photonics, Bahaa E. A. & Malvin Carl Teich, Wiley-Interscience, 2007.
2. Optics, Eugene Hecht, Addison-Wesley, 2001.

Reference Books:
1. Optical waves in layered media, Pochi Yeh, Wiley, 2005.
2. Principles of Optics, Max Born & Emil Wolf, Cambridge University Press, 1999.
3. Diode Lasers and Photonic Integrated Circuits, Coldren, and Corzine, Wiley-Interscience, 1995.
4. Physics of Optoelectronic Devices, Chuang, S. L., Wiley-Interscience, 1995.
5. Integrated optoelectronics: Waveguide optics, Photonics, Semiconductors, Karl J. Ebeling Springer London, 2011.
6. Handbook of Semiconductor Lasers and Photonic Integrated Circuits. London: Chapman and Hall, 1994.
7. Electromagnetic principles of integrated optics. Donald L. Lee , John Wiley & Sons, 1986.
8. Photonic Crystals: Molding the Flow of Light, John D. Joannopoulos et al, Princeton University Press, 2011.
9. Plasmonics: Fundamentals and Applications, S. A. Maier, Springer; 2007.

APC18102/APM18103 CHRACTERIZATION TECHNIQUES (3-0-0)/ (3-0-0)

Microscopic: Light microscopy- bright field, dark field, phase contrast illumination.
Spectroscopic: Spectrophotometry, Spectral reflectance, Ellipsometry, Luminescence spectroscopy, Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy, Surface plasmon resonance (SPR) spectroscopy, Dynamic light scattering (DLS), Inductively Couple Plasma Mass Spectroscopy (ICPMS). X-ray and Ultra-violet Photoelectron Spectroscopy (XPS & UPS), Energy Dispersive X-ray analysis (EDAX), X-ray Fluorescence Spectroscopy (XRF), Rutherford Backscattering Spectroscopy (RBS), Inductively Coupled Plasma Mass Spectrometry (ICPMS). X-ray diffraction (XRD), Transmission Electron diffraction (TED).
Structural: Scanning Electron Microscope (SEM), Transmission electron microscope (TEM), Atomic force microscopy (AFM), Magnetic force microscopy (MFM), Scanning tunneling microscopy (STM).
Magnetic: Vibrating Sample Magnetometer (VSM), Superconducting Quantum Interference Device (SQUID), and Magnetic Force Microscopy (MFM).
Thermal: Differential Scanning Calorimeter (DSC), Thermo-Gravimetric and Differential Thermal Analyzer (TG-DTA), Thermomechanical analyzer (TMA), Dynamic mechanical analyzer (DMA).

Textbooks:

1. Microstructural characterization of materials, D. Brandon and W. Kaplan, John Wiley & Sons, 2013.
2. Surface Characterization Methods: Principles, Techniques and Applications; Milling; CRC Press; 1999
3. ASM Handbook: Volume 10: Materials Characterization; George M. Crankovic; ASM International; 1986.

Reference Books:

1. Encyclopedia of Materials Characterization - Surfaces, Interfaces, Thin Films; Brundle, Richard, Evans & Shaun; Elsevier; 1992.
2. Characterization of Semiconductor Materials - Principles and Methods; McGuire; William Andrew Publishing/Noyes; 1989
3. Optical Techniques for Solid-State Materials Characterization, Rohit P. Prasankumar, Antoinette J. Taylor, CRC Press, 2010.
4. Foundation of Spectroscopy. Simon Duckett & Bruce Gilbert. Oxford University Press. 2005.
5. Frontier of Molecular Spectroscopy. Jaan, L. Elsevier S & T, 2008
6. Practical Handbook of Spectroscopy, James W. Robinson, CRC Press, 1991.
7. Surface and Thin Film Analysis: A Compendium of Principles, Instrumentation, and Applications, Gernot Friedbacher, Henning Bubert, John Wiley & Sons, 2011.
8. Elements of X-ray Diffraction, Cullity B D., Stock S R, Prentice Hall, Inc. 2001.
9. Scanning Electron Microscopy and X-ray Microanalysis: Third Edition, Joseph Goldstein, Springer, 2003.
10. The Principles and Practice of Electron Microscopy, Ian M. Watt, Cambridge University Press, 1997.
11. Principles of Thermal Analysis and Calorimetry, Peter J. Haines, Royal Society of Chemistry, 2002.

APC18103/APM18104 LASER PHYSICS AND TECHNOLOGY (3-0-0)/ (3-0-0)

Overview: Gaussian beam, Monochromaticity, Directionality, Coherence; Atomic energy levels.
Energy distributions and laser design: Boltzmann distribution, Population inversion, Rate equations, Stability conditions, Three level and four level lasers; Issues in designing a laser; Pumping mechanisms; Stable and unstable resonators, Laser Cavity, Longitudinal and Transverse Modes, Mode Selection, Gain in a Regenerative Laser Cavity; Q-switching, Mode locking, Laser amplification, Frequency conversion, Pulse expansion, Pulse shortening – Pico-second and Femto-second operations, Spectral narrowing and Stabilization.
Laser systems: Basics of tunable, ultrafast and power lasers; *Gas lasers*: He-Ne, He-Cd, Ar, Kr ion, CO_2, Excimer lasers; *Solid state lasers*: Diode pumped solid state lasers, Lamp pumping and thermal issues; Ruby, Nd-YAG, Fiber lasers; *Semiconductor lasers*: Laser materials, Laser structure, Frequency control of laser output, Modern diode laser, Quantum cascade lasers, p-Ge lasers, Vertical-cavity surface-emitting laser.
Applications of laser: Laser cooling; Laser barcode scanner, Laser trimming, Cutting, Welding, Drilling and Tracking, Pattern formation by laser etching; LIDAR; Laser-tissue interaction, Laser surgery; Holography, Interferometry, Microscopy.

Textbooks:

1. Laser Fundamentals, by William T. Silfvast, Cambridge University Press (2008)
2. Principles of Lasers, by Orazio Svelto; Springer, 4 ed (2009)

Reference Books:

1. Laser Physics, by Simon Hooker and Colin Webb; Oxford (2010)
2. Lasers, by A. E. Siegman; University Science Books (1986)
3. Laser Application in Surface Science and Technology, by H. G. Rubahn; John Wiley and Sons (1999)

4. Laser Physics, by P. W. Milonni, J. W. Eberly; John Wiley and Sons (2010)
5. Laser Cutting: Guide for manufacturing, by C. L. Caristan; Society of Manufacturing Engineers (2004)
6. Lasers – Theory and Applications, by K. Thyagarajan and A. K. Ghatak; Macmillan India, Delhi (1981)
7. Optical Electronics, by Ghatak & Thyagarajan, Cambridge
8. Essentials of Optoelectronics, by A. Rogers, Chapman Hall
9. Lasers and Non-Linear Optics, 2 ed, by B. B. Laud; New Age International, New Delhi (1991)
10. Laser Spectroscopy: Basic Concepts and Instrumentation, by Demtroder; Springer (2004)

APC18104/APM18105 COMPUTATIONAL PHYSICS (3-0-0)/ (3-0-0)

Numerical Techniques: Review of Numerical integration (Trapezoidal and Gaussian quadrature methods), Interpolation and extrapolation; linear algebra and matrix manipulations, inversion, diagonalization, eigenvectors and eigenvalues, root searching; random number and pseudorandom number generation, using random numbers to evaluate integrals. Introduction to Fast Fourier transform.
Random Walk: Theory and simulation of random walks in one, two and three dimensions. Self avoiding walk; Stochastic processes: Brownian motion.
Computer Simulations: 1. **Monte Carlo simulation**: Basic idea, Importance Sampling, Metropolis algorithm, Markov chain, and Some applications 2. **Molecular Dynamics**: Basic idea, Equation of motion; Program initialization, The force calculation, Integrating the equation of motion and Some applications.
Introduction to parallel computation.
Introduction to MatLab Programming.

Textbooks:
1. Numerical Recipes: The Art of Scientific Computing; William H. Press; Cambridge University Press; 2007
2. A Guide to Monte Carlo Simulations in Statistical Physics, D. P. Landau and K. Binder, Cambridge University Press.
3. I. Prigogine and Stuart A. Rice, New Methods in Computational Quantum Mechanics, Wiley

Reference Books:
1. Matlab: A Practical Introduction to Programming and Problem Solving; Stormy Attaway; Butterworth-Heinemann; 2011
2. FORTRAN 90 for Scientists and Engineers; Brian Hahn; Butterworth-Heinemann; 1990
3. Computer Programming in Fortran 77; V. Rajaraman
4. Computational Physics, Joseph Marie Thijssen, Cambridge University Press
5. An Introduction to Computational Physics, Tao Pang, Cambridge University Press
6. Computer Simulation of Liquids, M. P. Allen and D. J. Tildesley, Clarendon Press
7. D. Frankel and B. Smit, Understanding Molecular Simulation, second edition, Academic Press.
8. R. G. Parr and W. Yang, Density Functional theory of atoms and molecules.

Honors Course

APH15101 SENSOR AND TRANSDUCERS (3-0-0)

Basics of sensors and transducers: Principle, Classifications, Parameters: Characteristics, Environmental parameters.

Sensors:

Mechanical and Electromechanical sensors: Resistive potentiometer, Inductive sensor, Capacitive sensor, Stress sensors, Ultrasonic sensors.

Thermal sensors: Gas thermometric, Thermal expansion type thermometric, Resistance change type thermometric, Thermo-emf, Semiconductor junction type, Thermal radiation sensors.

Magnetic sensors: Magnetoresistive, Hall effect, Inductance, Eddy-current, Switching magnetic, SQUID sensors.

Radiation sensors: Characteristics, Photodetectors, X-ray and Nuclear radiation sensors, Fibre optic sensors.

Electroanalytical sensors: Electrochemical cell; Cell potential, Liquid junction and other potentials; Polarization; Electrodes.

Smart sensors, Recent trends in sensor technology; Applications of sensors.

Transducers:

Mechanical transducers: Temperature, Pressure, Force, Torque, Density, Liquid-level, Viscosity, Flow measurements; Displacement-to-Pressure transducer, Seismic displacement transducer.

Passive electrical transducers: Resistive, Inductive, Capacitive transducers.

Active electrical transducers: Thermoelectric, Piezoelectric, Magnetosrictive, Hall-effect, Electromechanical, Photoelectric, Ionization, Digital, Electrochemical transducers.

Feedback transducer systems: Temperature balance, Beam balance, Feedback accelerometer, Bimorph position-control systems.

Textbooks:

1. Sensors and Transducers by D. Patranabis; PHI, Eastern Economy Edition 2004
2. Transducers and Instrumentation (2 Ed) by D. V. S. Murty, PHI Learning (2008)

Reference Books:

1. Sensors and Transducers by Ian Sinclair, Newnes, 3rd Edition 2001
2. Sensors and Transducers by MJ Usher, Scholium International 1985
3. Sensors and Transducers by Kieth Briendley, CRC Press 1988

APH16101 LOW TEMPERATURE PHYSICS AND SUPERCONDUCTIVITY (3-0-0)

Cooling techniques and cryogenics: Liquefaction of gases, Expansion engines, operation principle and technical realizations, separation of liquefied gases, Inverse Carnot Engine, Joule-Thomson expansion, closed cycle refrigerators and Gifford-McMahon coolers, Pulse tube cooler, Liquid He cryostat. Basics of dilution refrigerator.

Basics of superconductivity: Zero resistance, perfect diamagnetism, type-II super conductor (shubinkov phase), flux quantization, flux pinning, Josephson effects.

Thermodynamics of superconductors: Condensation energy, entropy, specific heat capacity.

Electrodynamics of super conductors: Drude model, London theory. BCS theory of superconductivity, properties of fermions and coherent states of fermions. Ginzburg-Landau theory, phase transition, screening, GL coherence length.
Applications: Superconducting magnets, Magnetic levitation, application of Josephson junction, SQUID, high T_c superconductors.

Textbooks:
1. Low-temperature Physics: An introduction for scientists and engineers by PVE McClintock, DJ Meredith, JK Wigmore; Springer Science 1992
2. Low-temperature Physics by C. Enss, S. Hunk linger, Springer-Verlag Berlin Heidelberg 2005
3. Experimental Techniques for Low temperature measurements by JW Ekin, Oxford Univ. Press 2006

Reference Books
1. Matters and Methods at Low-Temperatures by Frank Pobel; Springer-Verlag Berlin Heidelberg 2007
2. Introduction to Superconductivity: Michael Tinkham; Dover Publications; Second Edition; 2004

APH17101 PLASMA ENGINEERING (3-0-0)

Concepts: Introduction, Plasma particle phenomena, Waves and instabilities in plasma, Plasma-wall interactions, Surface phenomena – Electron emission and Vaporization.
Plasma Diagnostics**:** Langmuir probes, Ion energy measurements – Electrostatic analyzer, Optical measurements and fast imaging, Plasma spectroscopy, Microwave scattering,
Electrical Discharge: Electrical breakdown and Paschen law, Spark discharges and streamer phenomena, Glow discharge, Arc discharges.
Plasma Dynamics: Plasma in electric and magnetic field, Particle drift, Crossed **E×B** fields plasma dynamics in plasma devices, Magnetic mirrors, Diffusion and transport of plasmas.
Controlled Nuclear Fusion: Toroidal magnetic confinement, Tokamaks, Tokamak instabilities, Radiofrequency heating of tokamak plasma, International Thermonuclear Experimental Reactor, Stellarators.
Plasma in Space Propulsion: Plasma in ablative plasma thrusters, Bulk plasma and near-wall phenomena in Hall thrusters, Micropropulsion, Plasma plumes from thrusters.
Plasma in Nanoscience and Nanotechnology: Plasma for nanotechnology, Magnetically enhanced synthesis of nanostructures in plasmas, Nanoparticle synthesis in electrical arcs.
Plasma Therapy: Plasmas for biological applications, Cold plasma interaction with cells, Application of cold atmospheric plasma (CAP) in cancer therapy.

Textbooks:
1. Plasma Engineering: Applications from Aerospace to Bio and Nanotechnology; Keidar, and Beilis; Academic Press, 2013
2. Plasma Physics: An Introduction to Laboratory, Space and Fusion Plasmas; Piel; Springer, 2010

Reference Books:
1. Plasma Physics and Engineering; Fridman and Kennedy; CRC Press, 2011
2. Introduction to Plasma Technology; Harry; Wiley, 2013
3. The Physics of Plasmas; Boyd and Sanderson, Cambridge University Press, 2003
4. Principles of Plasma Physics for Engineers and Scientists; Inan and Golkowski; Cambridge University Press, 2011
5. Plasma Physics and Fusion Energy; Freidberg; Cambridge University Press, 2007

APH17102 ASTROPHYSICS AND COSMOLOGY (3-0-0)

Fundamentals of Astrophysics:
Overview of major contents of universe, Mass, length and time scales in astrophysics, Celestial coordinates, Astronomy in different bands of electromagnetic radiation, Interaction of radiation with matter , Black body radiation, Basics of radiative transfer, Radiative transfer through stellar atmospheres, Stellar colors, Stellar distances, Basic knowledge of stellar atmospheres, Binaries, variable stars, clusters, open and globular clusters, Compact objects , Shape, size and contents of our galaxy, Normal and active galaxies, Evolution of a stars: White Dwarfs, Neutron stars, Supernovae, Pulsar, Stellar blackholes.
General Relativity: Foundations of general relativity, Riemannian geometry of Euclidean signature manifolds: tensors on Euclidean manifolds and their transformation laws; Christoffel symbol and Riemann tensor; geodesics; general properties of the Riemann tensor. Einstein's equation Schwarzschild and Kerr space-times
Cosmology: Introduction**,** observational tests, the early universe, the microwave background, formation of structures dark matter and dark energy**.** Cosmological models: principles of homogeneity and isotropy; Newtonian cosmology, FRW metric; open, closed and flat universes; relation between distance, red-shift and scale factor.

Textbooks:
1. Theoretical Astrophysics, Padmanabhan T., Vols. 1-3, Cambridge University Press, 2005.
2. Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press.
3. Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity, Steven Weinberg
4. An Introduction to Cosmology, 3rd Edition, Narlikar.
5. The Early Universe: E. Kolb and M.S. Turner.

Reference Books:
1. Shu, F., The Physical Universe, University of California, 1982.
2. Harwit, M. Astrophysical Concepts, 3rd ed, Springer-verlag, 2006.
3. Landau, L.D. & Lifshitz, E.M., The Classical Theory of Fields, 2nd ed., Pergamon Press, 1995.
4. Hartle, J. B., Gravity: Introduction to Einstein's General Relativity, Pearson Education, 2003.
5. Peebles, P.J.E., Physical Cosmology, Princeton University Press, 1993.

APH18101 NANOTECHNOLOGY (3-0-0)

Working environment: Cleanroom and classifications, Proper handling of materials, Types of contamination, Chemical and physical cleaning of specimen, Wet and Dry etching techniques. Environment safety and health regulations, societal implications and legal aspects.
Nanofabrication: Chemical synthesis techniques, Self-Assembled Monolayers (SAM), Langmuir–Blodgett method, Layer-by-Layer assembly; Nanolithography: Photolithography, Electron beam lithography, Nano-imprint Lithography, Dip-pen lithography, Two-Photon Polymerization, Focused Ion-Beam Technique, Ion-Beam Sculpting; Physical, Chemical and Epitaxial growth techniques of nanostructures.
Commercial production: Nanopattern structures, Nanoparticles-Metals, Alloys, Oxides; Carbon based nanomaterials: Graphene, Fullerene, Nanotubes; Transparent Conducting Oxides (TCO) films. Nanotechnology industries.
Applications: *Energy*-Photovoltaic, Fuel cells, Hydrogen energy; *Optoelectronics*- Single electron transistor, Quantum dot and quantum well laser, Flexible electronics; *Environment and Medical*- Wastewater

treatment, Air purification, Drug delivery and therapeutics, Chemical and Biological Sensors; Micro/nano electromechanical systems (MEMS/NEMS),

Textbooks:

1. Nanotechnology: An Introduction to Nanostructuring Techniques, Michael Köhler, Wolfgang Fritzsche, John Wiley & Sons, 2008.
2. Nanofabrication: Techniques and Principles, Maria Stepanova & Steven Dew, Springer; 2012.
3. Micro-Nanofabrication: Technologies and Applications, Zheng Cui, Springer, 2010.
4. Nanotechnology Applications and Markets, Lawrence Gasman, Artech House, 2006.
5. Nanotechnology: Health and Environmental Risks, by Jo Anne Shatkin; 2nd Edition, CRC Press, Boca Raton (2012).

Reference Books:

1. Fuel Cells, Hydrogen Energy and Related Nanotechnology – A Global Industry and Market Analysis, by Alton Parish, Innovative Research and Products, Stamford (2009).
2. Nanotechnology: Volume 8: Nanostructured Surfaces, Lifeng Chi, John Wiley & Sons, 2010.
3. Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications; Vladimir V. Mitin; Cambridge University Press; 2008
4. Nanofabrication: Fundamentals and Applications, Ampere A. Tseng, World Scientific, 2008.
5. Handbook of Nanofabrication, Gary Wiederrecht, Academic Press, 2010.
6. Nanofabrication Handbook, Stefano Cabrini, Satoshi Kawata, CRC Press, 2012.
7. Fundamentals of Microfabrication: The Science of Miniaturization, Marc J. Madou, CRC Press, 2002.
8. Introduction to Microfabrication, Sami Franssila, John Wiley & Sons, 2010.
9. Environmental and Human Health Impacts of Nanotechnology, Jamie R. Lead, Emma Smith, John Wiley & Sons, 2009.

APH18201 ADVANCED PHYSICS LAB ` (0-0-3)

Determination of transition temperature of high T_c superconductor; Indexing X-rays and electron diffraction patterns and identification of crystal structure; I-V characteristics of Si solar-cell and calculation of the efficiency; Study of line spectra of Li; GM counter; Vacuum and Gauges; Surface plasmon resonance sensors.

Sessional papers for Honors/Minor course

APD16301 BIOMEDICAL ENGINEERING (S) (3-0-0)

Introduction: What is Biomedical engineering? Modern health care system; Role of a Biomedical engineer; Recent advances and prospectus in future.

Anatomy and Physiology: Introduction; Cellular organization; Tissues; Major organ systems; Homeostasis; Biomolecules; Nucleic Acids; Proteins; communication systems; Engineering balances.

Biomechanics and biomolecular Engineering: Prelude; Viscoelastic properties; Mechanics of Materials, Cells, Tissues, and Organs; Cardiovascular dynamics; Biomaterials and Artificial organs; Transport processes; Drug delivery; Tissue Engineering; Antigens, Antibodies, Clinical use of Antibodies, Vaccines.

Bioinstrumentation and Imaging: Overview of measurement systems; Types of Sensors; Instruments in medical practice and in the research laboratory; Biomicroelectromechanical systems and lab-on-a-chip devices; X-rays and Ultrasound imaging; Magnetic Resonance Imaging (MRI), Computer Tomography (CT), Surgery; Nuclear medicine; Optical bioimaging; Image processing and analysis.

Text Books:

1. Biomedical Engineering - Bridging medicine and technology, W. M. Saltzman, Cambridge University Press, 2009.
2. Introduction to Biomedical Engineering, J. D. Enderle and J. D. Bronzino, Elsevier, 2012.

Reference Books:

1. Human Physiology - from cells to systems, L. Sherwood, Books/Cole, Cengage Learning.
2. Introduction to Biomedical Engineering, M. M. Domach, Prentice Hall, 2003.
3. Drug Delivery – Engineering principles for drug therapy, W. M. Saltzman, Oxford University Press, 2001.
4. Tissue Engineering – Principles for the design of replacement organs and tissues, W. M. Saltzman, Oxford University Press, 2004.
5. Introductory Biomechanics – From Cells to Organisms, C. R. Ethier, and C. A. Simmons, Cambridge University Press, 2009.
6. Text Book of Biomechanics, S. Pal, Viva Books, 2009.
7. Biomedical Imaging: Principles and Applications, Ed: Reiner Salzer, Wiley, 2012.
8. Introduction to medical imaging, N. B. Smith, A. Webb, Cambridge University Press, 2011.

APD17301 NON-LINEAR OPTICS (S) (3-0-0)

Introduction: Introduction to non-linear optical processes, Propagation of electromagnetic waves in nonlinear optical media. Nonlinear optical susceptibilities and Symmetry.

Processes: Three wave mixing: second harmonic generation, phase matching techniques, efficiency, parametric mixing, amplification and oscillation, power considerations. Four wave mixing: Optical phase conjugation. Stimulated Raman Scattering: Electromagnetic theory of Stimulated Raman Scattering, Quantum mechanical description of Raman Scattering. Anti-Stokes scattering. Optical Kerr effect. Nonlinear Spectroscopy. Multiphoton processes. Self-focusing self-induced transparency. Use of density matrix and perturbative approach to nonlinear optical susceptibilities and application to specific interactions. Dyes. Organic Solids. Other inorganic solids and special materials.

Devices: Photorefractive crystals, theory and application to imaging. Electro -Optic effect, Retardation, electro-optic modulators. Acousto optics, acousto optic materials and acousto optic modulators. Magneto-optic effect. Retardation and modulators. Quantum detectors, limits of detection systems, noise in optical detectors.

Textbooks:

1. Non-linear optics, R.W. Boyd, Academic press, Elsevier, 2008.
2. Essentials of Lasers and Non-Linear Optics; Baruah; Pragati Prakashan; 2000.
3. Quantum Electronics, Amnon Yariv, John Wiley & Sons, 1989.
4. Handbook of Nonlinear Optics, R. L. Sutherland, 2003.

Reference Books:

1. Nonlinear Optics; Nicolaas Bloembergen; World Scientific Pub Co Inc; 1996
2. Laser and Non-Linear Optics; Laud; New Age; 1991
3. Lasers; Anthony E. Siegman; University Science Books; 1986
4. Principles of Nonlinear optics, Y. R. Shen, A Wiley Inter-science Publication, 1984.
5. Light-Matter Interactions, W. T. Hill and C. H. Lee, Wiley-VCH, 2007.
6. Essentials of Nonlinear Optics, Y. V. G. S. Murthy and C. Vijayan, Wiley, 2014.