

**DEPARTMENT OF APPLIED PHYSICS
INDIAN SCHOOL OF MINES, DHANBAD**



**COURSE STRUCTURE & SYLLABUS
FOR
5-YEARS INTEGRATED M.Sc.
IN
APPLIED PHYSICS**

Effective from 2008-2009

Course structure

Five Year Integrated M.Sc. (Applied Physics)

SEMESTERS-I & II

Sl No.	Course No.	Name of the Course	L	T	P	Credit Hrs.
1.	AMC 11101	Mathematics-I /	3	1	0	7
	AMC12101	Mathematics-II				
2.	APC 11101/12101	Physics /	3	1	0	7
	ACC 11101/12101	Chemistry				
3.	MMC 11101/12101	Engineering Graphics /	1	3	0	5
	MMC 11102/12102	Manufacturing processes				
4.	EEC 11101/12101	Electrical Technology /	3	1	0	7
	EIC 11101/12101	Electronics engineering				
5.	MMC 11103/12103	Engineering Mechanics /	3	1	0	7
	HSC 11101/12101	English for Science & Technology				
6.	GLD11301/12301	Earth System Science (S) /	3	0	0	6
	ESD11301/12301					
	MSD 11301/12301	Disaster Management and				
	APD 11301/12301	Energy Resources (S)				
7.	CSC11301/12301	Computer Programming (S)/	3	0	0	6
	HSC 11301/12301	Value Education, Human Right and Legislative Procedure (S)				
* Practicals						
8.	APC 11201/12201	Physics /	0	0	3/2	1.5
	ACC 11201/12201	Chemistry				
9.	EEC 11201/12201	Electrical Technology /	0	0	3/2	1.5
	EIC 11201/12201	Electronics Engineering				
10.	DSW	Co-Curricular Activities (Only for II nd Semester)	0	0	0	(3)
TOTAL FOR IST SEMESTER			19	7	3	48
TOTAL FOR IIND SEMESTER			19	7	3	48 + (3)

SEMESTER-III

	Course Name	Course No.	L T P	Credit Hrs.
1)	Mechanics-I	APR 93101	4 - 0 - 0	8
2)	Optics	APR 93102	4 - 0 - 0	8
3)	Waves & Oscillation	APR 93103	4 - 0 - 0	8
4)	Methods of Applied Mathematics-I (Capsule course)	AMR 13101	4 - 1 - 0	9
5)	Inorganic Chemistry-I	ACR 13120	3 - 0 - 0	6
6)	Physics Lab.-III	APR 93201	0 - 0 - 3	3
7)	Physics Lab.-IV	APR 93202	0 - 0 - 3	3
8)	Inorganic Chemistry Lab-I	ACR 13220	0 - 0 - 3	3
		Total	19 - 1 - 9	48

SEMESTER-IV

	Course Name	Course No.	L T P	Credit Hrs.
1)	Mechanics-II	APR94101	3 - 0 - 0	6
2)	Electricity and Magnetism	APR94102	3 - 0 - 0	6
3)	Inorganic Chemistry -II	ACR14123	3 - 0 - 0	6
4)	Numerical and Statistical Methods (Capsule course)	AMR14101	4 - 0 - 0	8
5)	Numerical and Statistical Methods Practical (Capsule course)	AMR14201	0 - 0 - 3	3
6)	Scientific Ethics	HSC35108	3 - 0 - 0	6
7)	Physics Lab.-V	APR94201	0 - 0 - 3	3
8)	Physics Lab.-VI	APR94202	0 - 0 - 3	3
9)	Physical Chemistry Lab-I	ACR14122	0 - 0 - 3	3
10)	Co-Curricular Activity	SWC94701	0 - 0 - 0	3
		Total	16- 0- 12	47

SEMESTER-V

	Course Name	Course No.	L T P	Credit Hrs.
1)	Fundamentals of Solid state Physics	APC95101	4 - 1 - 0	9
2)	Modern Physics	APC95102	4 - 1 - 0	9
3)	Heat and Thermodynamics	APC95103	4 - 1 - 0	9
4)	Data Structure (Capsule course)	CSR 13101	3 - 0 - 0	6
5)	Digital Electronics (Capsule course)	EIR 13101	3 - 0 - 0	6
6)	Physics Lab.-VII	APC95201	0 - 0 - 3	3
7)	Physics Lab.- VIII	APC95202	0 - 0 - 3	3
8)	Seminar – I	APC95401	0 - 0 - 0	3
		Total	18- 3- 6	48

SEMESTER-VI

	Course Name	Course No.	L T P	Credit Hrs.
1)	Elements of Nuclear and Particle Physics	APC96101	4 – 1 - 0	9
2)	Plasma Physics	APC96102	4 – 1 - 0	9
3)	Computer Networks (Capsule course)	CSR 16101	3 – 0 - 0	6
4)	Microprocessor & Applications (Capsule course)	EIR 14101	3 – 0 - 0	6
5)	Communication Skills	HSC36107	3 - 1 - 0	7
6)	Physics Lab.-IX	APC96201	0 - 0 - 3	3
7)	Physics Lab.-X	APC96202	0 - 0 - 3	3
8)	Seminar-II	APC96401	0 - 0 - 0	3
9)	Summer Training (Two weeks)	APC96901		
	Marks to be added in the next semester			
		Total	17 – 3 - 6	46

SEMESTER – VII

	Course Name	Course No.	L- T- P	Credit Hrs
1)	Classical Mechanics	APC97101	3- 0- 0	6
2)	Methods of Mathematical Physics	APC97102	3- 0- 0	6
3)	Solid State Electronics	APC97103	3- 0- 0	6
4)	Analog Communication (Capsule course)	EIC 15103	3- 0- 0	6
5)	Computer programming	AMC31102	3- 1- 0	7
6)	Computer programming lab	AMC31202	0– 0-2/2	1
7)	Experimental Physics-I	APC97201	0- 0- 8	8
8)	Summer Training	APC97901		4
		Total	15 -1-9	44

SEMESTER – VIII

	Course Name	Course No.	L- T- P	Credit Hrs
1)	Quantum Mechanics	APC98101	3- 0- 0	6
2)	Atomic and Molecular Physics	APC98102	3- 0- 0	6
3)	Electrodynamics	APC98103	3- 0- 0	6
4)	Seismology (Capsule course)	GPC 96102	3- 0- 0	6
5)	Object Oriented Programming	AMC32101	3- 0- 0	6
6)	Object Oriented Programming Lab	AMC32201	0 -0- 2	2
7)	Experimental Physics-II	APC98201	0 -0- 8	8
8)	Summer Training (Two weeks)	APC98901		
	Marks to be added in the next semester			
		Total	15 – 0 – 10	40

SEMESTER – IX

Course Name	Course No.	L- T- P	Credit Hrs
1) Condensed Matter Physics	APC99101	3- 1- 0	7
2) Laser & Holography	APC99102	3- 1- 0	7
3) Nuclear Physics & Special Theory of Relativity	APC99103	3- 1- 0	7
4) Statistical Mechanics	APC99104	3- 1- 0	7
5) Elective-I (Any one from)- i) Non-linear Optics ii) Space Physics and Astrophysics	APE99101 APE99102	3- 0- 0	6
6) Experimental Physics-III	APC99201	0 –0–8	8
7) Seminar- III	APC99401	0 - 0 - 0	6
8) Summer Training	APC99901		4
	Total	15- 4 –8	52

SEMESTER – X

Course Name	Course No.	L- T- P	Credit Hrs
1) Non-conventional Sources of Energy	APC90101	3- 0- 0	6
2) Superconductivity	APC90102	3- 0- 0	6
3) Elective –II (Any one from)- i) Physics of Nano Materials ii) Optical Communication	APE90101 APE 90104	3- 0- 0	6
4) Elective – III (Any one from)- i) Biomedical Physics ii) Environmental Physics	APE90102 APE90103	3- 0- 0	6
5) Project & Dissertation	APC90801	0- 15- 0	15
6) Viva-voce on dissertation	APC90802	0- 0- 0	4
7) Comprehensive Viva	APC90501	0- 0- 0	4
	Total	12-15- 0	47

SEMESTER-I & II

AMC 11101

MATHEMATICS-I

(3-1-0)

Calculus-I: Successive differentiation of one variable and Leibnitz theorem, Taylor's and Maclaurin's 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, Parseval'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

(3-1-0)

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 packet and wave function, Shrodinger 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.

ACC11101/ACC12101

CHEMISTRY

(3-1-0)

Cement: Manufacturing, composition, setting and hardening of cement.

Glass: Types of Glasses, Manufacturing & properties of Glasses.

Polymers: Classification, structure – property relationship, conductive polymers.

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, Cetane 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 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 AC circuits with balanced and unbalanced loads, phasor presentation, measurement of three-phase power by two-wattmeter method.

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

DC Machines: Construction, types, principle of operation, EMF and torque equation.

DC generator: OCC and external characteristic curves and efficiency

DC motors: speed-torque characteristics, starting, 3- point starter, speed control and efficiency.

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

Introduction to three-phase synchronous motor.

EIC 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 OPAMP Circuits.

Introduction to field effect Transistors and their applications.

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 EARTH SYSTEM SCIENCE (3-0-0)
ESD 11301/12301

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, Landslides, Volcanoes.

Geological Oceanography: Sea waves, Tides, Ocean Current, Geological Work of seas and Oceans, Tsunami and its Causes, Warning system and mitigation

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

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

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

ESE (1 0 0)

Earth's Atmosphere: Structure and composition of atmosphere, Atmospheric circulation, Geological work of wind, Greenhouse effect and Global Warning, Carbon dioxide sequestration. Steps to maintain clean and pollution free atmosphere with governing laws, Precautionary measures against disasters.

Biosphere: Origin of life, Evolution of life through ages, Geological time scale, Biodiversity and its conservation.

Natural Resources: Renewable and non-renewable resources, Mineral and fossils fuel resources and their geological setting; Mining of minerals and conservation, Effect of mining on surface environment.

MSD 11301/12301 DISASTER MANAGEMENT AND (3-0-0)
APD 11301/12301 ENERGY RESOURCES

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

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.

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++.

PRACTICALS:

APC 11201 / APC 12201 PHYSICS (0-0-3)

Measurement of thermal conductivity of bad conductors, Optical experiments on Diffraction using diffraction grating, Experiments on Semi-conductors – Measurement of band gap and Hall Effect, Experiments using He-Ne Laser - Diffraction Experiments to measure diameter of circular aperture, Polarisation Experiments to measure Brewster's angle & refractive index.

ACC 11201 / ACC 12201 CHEMISTRY (0-0-3)

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 11201/12201 ELECTRICAL TECHNOLOGY (0-0-3)

Experiments on Thevenin's theorem, R-L-C Series circuit, Single phase power measurement, 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.

EIC 11201/12201 ELECTRONICS ENGINEERING (0-0-3)

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

APR 93101

MECHANICS-I

(4 - 0 - 0)

Law of motion, motion in a uniform field, components of velocity and acceleration in different coordinate systems, uniformly rotating frame, Centripetal acceleration, Coriolis force and its applications.

Motion under central force, Kepler's law, Gravitational law and field, Potential due to a spherical body, Gauss and Poisson equations for gravitational self-energy, Earthquakes, Seismic waves and Seismographs, Galitzin's Seismograph, Determination of the Epicentre and the focus, Modern application of seismology.

System of particles, Centre of mass, equation of motion, conservation of linear and angular momenta, Conservation of energy, single stage and multistage rockets, elastic and inelastic collisions.

Rigid body motion, Rotational motion, Moment of inertia and their products, principal moments and axes, Euler's equations, precessional motion, top, Gyroscope.

Kinematics of moving fluids, equation of continuity, Bernoulli's theorem, viscous fluids, streamline and turbulent flow, Poiseuille's law, capillary tube flow, Reynold's number, Stoke's law.

Surface tension and surface energy, molecular interpretation of surface tension, pressure on a curved liquid surface, wetting.

APR 93102

OPTICS

(4 - 0 - 0)

Geometrical Optics:

Fermat's Principle: Principle of extremum path, aplanatic points of a sphere and other applications.

General theory of image formation: Cardinal points of an optical system, general relationship, thick lens and lens combinations. Lagrange's equation of magnification, telescopic combination, telephoto lenses and eyepieces.

Aberration in images: Chromatic aberrations, achromatic combination of lenses in contact and separated lenses, Monochromatic aberrations and their reductions; aspherical mirrors and Schmidt corrector plates, aplanatic points, oil immersion objectives, meniscus lens.

Optical instruments: Entrance and exit pupils, need for a multiple lens eyepiece, common types of eyepieces.

Physical Optics:

Interference of light: The principle of superpositions, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localised fringes; thin films, applications for precision measurements for displacements.

Haidinger fringes: Fringes of equal inclination. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Twyman-Green interferometer and its uses. Intensity distribution in multiple beam interference, Tolansky fringes, Fabry-Perot interferometer and etalon.

Fresnel diffraction: Fresnel half-period zone plates, straight edge, rectilinear propagation
 Fraunhofer 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, resolution of images, Rayleigh criterion, resolving power of telescope and microscope systems, outline of phase contract microscopy.

Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving powers of prism and of a Fabry-Perot etalon

Double refraction and optical rotation: Refraction in uniaxial crystals, its electromagnetic theory. Phase retardation plates, double image prism. Rotation of plane of polarization, origin of optical rotation in liquids and in crystals, Applications.

APR 93103

WAVES & OSCILLATION

(4 - 0 - 0)

Waves:

Waves in a one-dimensional chain of particles; classical wave equation; wave velocity, boundary conditions and normal modes, dispersion relations, dispersive waves, acoustic and optical modes.

Waves in continuous media: Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, typical measurements, dispersion in waves, group velocity and phase velocity, their measurements.

Superposition of waves: Linear homogeneous equations and the superposition principle, interference in space and energy distribution; beats and combination tones.

Ultrasonic: Production, detection and applications of ultrasonic waves.

Oscillations:

Free oscillations of simple systems: Equilibrium; concept of potential well, small oscillations, approximate solutions, linear and transverse oscillations of a mass between two springs, diatomic molecule, reduced mass concept.

Damped and forced oscillations: Damped oscillations; critical damping, Q of an oscillator. Forced oscillator with one degree of freedom; Transient and steady state oscillations, resonance energy absorption, low and high frequency responses.

Free oscillations of system with two degrees of freedom: Two dimensional oscillator; normal modes, longitudinal and transverse oscillation of coupled masses, energy transfer between modes, coupled pendulum.

Fourier analysis: Fourier series and Fourier coefficients; simple examples, use of exponential representation for harmonic oscillations, expression for Fourier coefficients. Non-periodic disturbance; representation by Fourier integral, Fourier transform. Case of a wave train of finite length, constancy of $\Delta x \Delta k$ (the uncertainty product), applications.

AMR 13101

METHODS OF APPLIED MATHEMATICS-I

(4-1-0)

Section-A: Analysis of Complex Variables: Limit, continuity and differentiability of function of complex variables. Analytic functions, Cauchy-Riemann's and Cauchy's integral theorem, Morera's theorem, Cauchy's integral formula, Expansion of function of complex variables in Taylor's and Laurent's series, singularities and poles. Residue theorem, contour integration, conformal mappings and its application, Bilinear Transformation.

Section-B: Special Functions: Solution in series of ordinary differential equations, Solution of Bessel and Legendre equations, recurrence relations and generating function for $J_n(x)$, orthogonal property and integral representation of $J_n(x)$. Legendre polynomial, Rodrigue's formula, orthogonality properties and generating function for $P_n(x)$. Elliptic integrals and Error function and their properties.

Section-C: Laplace Transform and PDE: Laplace Transform of simple functions, first and second shifting theorems, t-multiplication and t-division theorems, Laplace transform of derivatives, integrals and periodic functions. Inverse Laplace transform and convolution property. 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 in cartesian and polar coordinates by variable separable method with reference to Fourier trigonometric series and by Laplace transform technique.

ACR 13120

INORGANIC CHEMISTRY – I

(3 - 0 - 0)

Periodic Properties

Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

Chemical Bonding

Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3 , H_3O^+ , SF_4 , ClF_3 , ICl_2 and H_2O . MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Ionic Solids – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories.

Weak Interactions – Hydrogen bonding, Van der Waals forces.

s-Block Elements

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

APR 94102

ELECTRICITY AND MAGNETISM**(3-0-0)**

Electric field: Coulomb's law; unit of charge (SI and other systems of units), Conservation and quantisation of charge; field due to different charge distributions, monopole, dipole, quadrupoles, line charge, sheet charge. Torque on a dipole in uniform field and non-uniform fields, flux of an electric field. Gauss's law; applications to deduce E fields, force per unit area on the surface of a charged conductor.

Potential: Line integral of electric field and electrical potential; field as the gradient of potential. Potential energy of a system of charges; pair of charges, line charge, sheet charge, spherical shell of charge, charged hollow disc. Field equations for E in vacuum. Energy associated with E field. Differential form of Gauss' divergence law, Poisson's equation, Laplace's equation, boundary conditions, and Uniqueness theorems.

Electric field around conductors: Induced charges; field and potential inside a conductor, field near the surface of a conductor, method of images.

Electric fields in matter: Atomic and molecular dipoles; induced dipoles, polarisability tensor, electronic and molecular contributions. Electrical field caused by polarized matter, E and D fields, permittivity, dielectric constant. Capacitor field with a dielectric, field equations in presence of dielectric. The field of a polarized sphere, dielectric sphere in a uniform field. Energy in dielectric systems; polarisability and susceptibility, frequency dependence of polarisability, Clausius-Mossotti equation.

Magnetic effect of current: A critical review.

Magnetic field: magnetic field B seen through Lorentz force on a moving charge, unit for I defined through force on a straight current, torque on a current loop in B field, magnetic dipoles in atoms and molecules, gyromagnetic ratio.

ACR 14123

INORGANIC CHEMISTRY-II**(3-0-0)****Chemistry of Elements of First Transition Series**

Characteristic properties of d-block elements.

Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

Chemistry of Elements of Second and Third Transition Series

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

Oxidation and Reduction

Use of redox potential data – analysis of redox cycle, redox stability in water – Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Chemistry of Lanthanide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Acids and Bases

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases.

Non-aqueous Solvents

Reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2 .

AMR 14101 NUMERICAL AND STATISTICAL METHODS (4-0-0)**A. Numerical Methods**

Solution of algebraic and transcendental equations by bisection, iteration, false position, secant and Newton-Raphson methods. Generalized Newton's method for multiple roots. Solution of a system of linear simultaneous equations by Gauss elimination, Gauss-Jordan, Crout's triangularisation, Jacobi and Gauss Seidal methods. Finite differences, Symbolic relations, differences and factorial notation of a polynomial, data smoothing, interpolation and extrapolation, Newton-Gregory forward and backward, Gauss forward and backward, Stirling, Bessel, Everett, Lagrange and Newton's divided difference formulae, Inverse interpolation by Lagrange and interactive methods; Cubic splines, Numerical differentiation and integration, Trapezoidal, Simpson's $1/3^{\text{rd}}$ Simpson's $3/8^{\text{th}}$, and Weddle and Gaussian quadrature formulae.

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

B. Statistical Methods

Concept of frequency distribution: Moments, skewness and kurtosis.

Probability: Various approaches of probability-classical, frequency (statistical), subjective and axiomatic. Theorems on probability, conditional probability, independence, Bayes theorem.

Random variable – discrete and continuous, Distribution function and their properties, probability mass and density functions, Mathematical expectation, Moment generating function and its properties.

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

Theory of least squares and curve fitting.

Correlation-Simple, multiple and partial, Regression lines, regression coefficients, Multiple and partial regression.

Test of Significance: Normal test, t-test, Chi-square test and F-test.

AMR 14201 NUMERICAL & STAT. METHODS PRACTICAL (0-0-3)

Numerical Methods; Numerical solution of non-linear algebraic and transcendental equations by Iteration Method, Newton-Raphson Method and Method of false position; Interpolation by Lagrange's Method; Numerical Integration by Trapezoidal Rule, Simpson $1/3^{\text{rd}}$ & $3/8^{\text{th}}$ Rule and Weddles Rule; Numerical solution of ordinary

differential equations by Eulers, Modified Eulers, Runge-Kutta and Milne's Predictor-corrector Method.

Statistical Methods: Preparation of frequency distribution table for discrete & continuous data, Ogive curves; Measures of central tendency, dispersion, skewness and kurtosis; Curve fitting of straight line, second degree polynomial, exponential and power curves; Correlation and regression lines, multiple and partial correlation; Tests of significance of mean and variance based on one & two normal populations ; Quality control (Control Charts for mean & range).

HSC 35108

SCIENTIFIC ETHICS

(3- 0 - 0)

Part I , Basic Concepts in Ethics

Ethics, Science, and the Environment, Ethical Theories,

Part II, Responsible Conduct of Research and Applied Ethics

To What Extent Does the Scientist Have an Ethical Obligation to be Reliable? Philosophical Principles of the Scientific Method, The Role of Trust in Knowledge, The Scientific Method and Ethical Methodologies, Research as a Moral Enterprise,

Conducting Research and Reporting Results:

Issues in Experimental Design; Data Selection and Retention; Data Sharing, Ownership, and Management; Reporting Preliminary Data; Publication Issues, Null Results, Attribution, Credit, Plagiarism, Intellectual Property Issues, Academia and Industry Collaborations, Peer Review and Funding Issues, Conflict of Interest Presented by Research, The Scientist in the Public Forum.

Scientific Misconduct, Scientific Objectivity:

Conflict of Interest: A Brief History of Scientific Misconduct; Distinguishing among Error, Deception and Fraud, Reporting Scientific Misconduct

Research in Human Subjects, Part I

Historical Perspective; Eugenics and Euthanasia, Antecedents to Consequentialistic approaches towards Human Research Subjects; Nazi Death Camp Experiments, the Genesis of The Nuremberg Code and the Declaration of Helsinki; Historical Cases in Human Subjects's Violations; Recent Cases in Human Subject's Violations; Ethical Principles; Informed Consent

Research in Human Subjects, Part II

Data Issues and Implications of HIPAA; Role of Oversight Bodies; DSMB, IRB, etc; Reporting of Adverse Events

Issues in Animal Research

Assessing Requisiteness of Animal Research Subjects; Pain Experiments

Human Genetics Research

The Human Genome Project; Philosophical and Theological Implications of Recent Genetics Research; Issues in Genetic Screening; Genetic Modification and Gene Therapy.

SEMESTER -V

APC 95101 FUNDAMENTALS OF SOLID STATE PHYSICS (4 – 1 – 0)

Overview: Crystalline and glassy forms, liquid crystals, glass transition.

Structure: Crystal structure; periodicity, lattices and bases, fundamental translational vectors, unit cell, Wigner-Seitz cell, allowed rotations, lattice types, lattice planes, common crystal structures.

Laue's theory of X-ray diffraction, Bragg's law, Laue patterns.

Bonding: Potential between a pair of atoms; Lennard-Jones potential, concept of cohesive energy, covalent, Van der Waals, ionic, and metallic crystals.

Magnetism: Atomic magnetic moment, magnetic susceptibility, Dia-, Para-, and Ferromagnetism, Ferromagnetic domains, Hysteresis.

Thermal properties: Lattice vibrations, simple harmonic oscillator, second order expansion of Lennard-Jones potential about the minimum, vibrations of one dimensional monatomic chain under harmonic and nearest neighbour interaction approximation, concept of phonons, density of modes (1-D), Debye model; lattice specific heat, low temperature limit, extension (conceptual) to 3-D.

Band structure: Electrons in periodic potential: nearly free electron model (qualitative), energy bands, energy gap, metals, insulators, semiconductors.

APC 95102 MODERN PHYSICS (4 – 1 – 0)

Phenomenon in a discharge tube, Positive Ray analysis, Mass spectrometry, Compton, Rayleigh & Raman Scattering, Natural and artificial radioactivity, particle accelerators, Fission and fusion, Chain reaction, controlled chain reaction, Nuclear reactions, various radiations (Cherenkov & Bremsstrahlung's radiation), cosmic rays & cosmic ray showers.

Continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X-rays, Moseley's law, structure of X-ray spectra, X-ray absorption spectra.

Spectroscopic techniques: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments, different recording systems.

Raman effect, Stokes and anti-Stokes lines, experimental arrangement for Raman spectroscopy.

APC 95103 HEAT AND THERMODYNAMICS (4 – 1 – 0)

Ideal Gas: Kinetic model, deduction of Boyle's law, interpretation of temperature, estimation of rms speeds of molecules. Brownian motion, estimate of the Avogadro number. Equipartition of energy, specific heat of monatomic gas, extension to di- and

triatomic gases, Behaviour at low temperatures. Adiabatic expansion of an ideal gas, applications to atmospheric physics.

Real Gas: van der Waals gas, equation of state, nature of Van der Waals forces, comparison with experimental P-V curves. The critical constants, gas and vapour. Joule expansion of ideal gas, and of a Van der Waals gas, Joule coefficient, estimates of J-T cooling.

Liquefaction of gases: Boyle temperature and inversion temperature. Principle of regenerative cooling and of cascade cooling, liquifaction of hydrogen and helium. Refrigeration cycles, meaning of efficiency.

Transport phenomena in gases: Molecular collisions, mean free path and collision cross sections. Estimates of molecular diameter and mean free path. Transport of mass, momentum and energy and interrelationship, dependence on temperature and pressure.

The laws of thermodynamics: The Zeroth law, various indicator diagrams, work done by an on the system, first law of thermodynamics, internal energy as a state function and other applications. Reversible and irreversible changes, Sterling engine, Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics. Different versions of the second law, practical cycles used in internal combustion engines. Entropy, principle of increase of entropy. The thermodynamic scale of temperature; its identity with the perfect gas scale. Impossibility of attaining the absolute zero; third law of thermodynamics.

Thermodynamic relationships: Thermodynamic variables; extensive and intensive, Maxwells general relationships, application to Joule-Thomson cooling and adiabatic cooling in a general system, van der Waals gas, Clausius-Clapeyron heat equation. Thermodynamic potentials and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization, production and measurement of very low temperatures,

Blackbody radiation: Pure temperature dependence, Stefan-Boltzman law, pressure of radiation. Spectral distribution of BB radiation, Wien's displacement law, Rayleigh-Jeans law, the ultraviolet catastrophe, Planck's quantum postulates, Planck's law, complete fit with experiment.

Interpretation of behaviour of specific heats of gases at low temperature.

CSR 13101

DATA STRUCTURES

(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.

Action integrals, Principle of least action; derivation of equations of motion; variation and end points; Hamilton's principle and characteristic functions; Hamilton-Jacobi equation. Canonical transformation; generating functions; Properties; group property; examples; infinitesimal generators; Poisson bracket; Poisson theorems; angular momentum; small oscillations, normal modes and coordinates.

APC 97102 METHODS OF MATHEMATICAL PHYSICS (3-0-0)

Vector Spaces and Matrices, linear independence; Bases; Dimensionality; Inner product; Linear transformations; Solutions of equations using matrices, Orthogonal and unitary matrices; Eigenvalues and eigenvectors; Diagonalization; Complete orthonormal sets of functions; 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; recursion relations.

Integral Transforms, Laplace transform (LT); First and second shifting theorems; Inverse LT by partial fractions; LT of derivative and integral of a function; Solution of differential equation using LT, Fourier series; Fourier series of arbitrary period; Half-wave expansions; Partial sums; Fourier integral and transforms; Laplace Transform and Fourier Transform of delta function and their uses.

APC 97103 SOLID STATE ELECTRONICS (3-0-0)

Lattice Dynamics: Vibration of monoatomic lattices, vibrations of lattice with two atoms per unit cell, quantisation of lattice vibrations, interaction of electromagnetic waves and particle waves with phonons.

Dielectric properties: Static, electronic, ionic and orientational Polarization, Lorentz internal field, dielectric loss and relaxation time, absorption of solids including coal and rocks, Piezo, Pyro, Ferro electric properties and applications.

Semi-conductor Physics: Charge carrier density in intrinsic semiconductors, doping of semi-conductors, carrier densities in doped semiconductors, conductivity of semiconductors, Hall effect, (Classical and Quantum), semi-conductor Hetro-structures and Super lattices. P.N. Junction, metal-semiconductor junction, Transistors, Luminescence, photo conductivity and optical absorption Diffusion.

Material Preparation and Characterization: Crystal growing, After growth Quality improvement, thin film deposition and Electro-ceramics, Analytical techniques like X-ray diffraction, Infra-red and Atomic absorption Spectroscopy, Synthesis & characterization of Nano-materials and properties, CVD, MBE.

EIR 17101 COMMUNICATION ENGINEERING (3-0-0)

Elements of an Electrical Communication System, Analog Modulation Techniques (Block diagrams only)-AM, DSB, SSB, FM, PM, Random Processes, Effect of noise on analog modulation techniques, Pulse modulation-Sampling, PCM, DM, DPCM, Baseband Pulse transmission-Matched filter, Intersymbol interference, Passband Digital

Dielectrics, Multipole Expansion of the Energy of a Charged Distribution in an External field, Boundary value problems with dielectrics.

Steady currents, Magnetostatics, Vector potential Magnetic Induction for a circular Current Loop, Methods of Solving Boundary Value Problems in Magnetostatics, Uniformly magnetized sphere in an external field, Numerical Methods for two-Dimensional Magnetic Fields.

Time varying fields, Maxwell's equation, Gauge Transformation, Lorentz Gauge, Coulomb Gauge, Retarded solution for fields, Dirac quantization condition.

Lorentz force equation and motion of charges, Plane electromagnetic waves, Refraction and Reflection of Electromagnetic wave at a Plane interface Between Two Dielectrics, Simplified Model of Propagation in the Ionosphere and Magnetosphere, Illustration of the Spreading of a Pulse as it propagates in a Dispersive Media.

Wave-guide and resonant cavities, Field at the Surface of and within a Conductor, Cylindrical Cavities and Wave guides, Modes in rectangular wave guide, Power Losses in a cavity, Q of a Cavity, Earth and Ionosphere as a Resonant Cavity.

Propagation of electromagnetic wave in ionosphere.

GPC 96102

SEISMOLOGY

(3-0-0)

Introduction to Seismology and phenomena of earthquake and its effects. Elastic rebound theory, causes of intra and inter plate earthquakes, classification of earthquakes based on depth and magnitude.

Localizing of magnitude scale, various magnitude scales and their limitations, seismic moment, stress drop and dimension of rupture during earthquakes.

Intensity scales: MM and MSK, impacts and assessment of earthquakes and related hazard and their mitigation.

Theory of elasticity, generalized Hooke's law, different types of elastic waves and their propagation, characteristics, equation of motion of seismic body waves, Attenuation and dispersion of seismic waves.

Instruments: Amplitude and phase characteristics of seismometers, short-period, long period and broad-band seismometers, analysis of seismograms and identification of various phases on the seismograms, basic principle of strong motion instrument.

Ray characteristics and related parameters for horizontally and spherically stratified earth, basic principles of seismic tomography and receiver function analysis.

Fault plane solutions and related interpretation, moment tensors for different fault patterns, earthquake characteristics along constructive, conservative and destructive boundaries, Study of micro-earthquakes and induced seismicity, free oscillations of earth.

Seismic networks and arrays, stand-alone and telemetry systems.

Earthquake prediction: dilatancy theory, Short-term, middle-term and long-term prediction.

AMC 32101

OBJECT ORIENTED PROGRAMMING (OOP)

(3-0-0)

OOPs: Basic concepts of OOPs ; C++ preliminaries, data types, arrays, functions, classes and objects, constructors and destructors, function overloading, operator overloading and Type conversions; inheritance, pointers, polymorphism, console oriented I/O operations, file management, templates, exception handling.

JAVA: Introduction to JAVA.

Information Technology: Introduction to Data Base Management System, Foxpro, RDBMS, HRDBMS, Relational Data Base, Introduction to Internet and intranet Multimedia.

AMC 32201 OBJECT ORIENTED PROGRAMMING LAB (0-0-2)**C++ programming:**

Classes and objects, Arrays of objects, Passing objects to member functions, Function overloading, Friend functions, Passing objects to friend functions, Member functions /Friend functions returning objects, Pointer: Accessing data members and member functions using pointers, Constructors and Destructors: constructors, parameterized constructors, overloaded constructors, Copy constructors, Dynamic constructors; destructors, Operator Overloading: Overloading of unary operators such as minus, increment operator, decrement operator etc.; Overloading of binary operators such as +, * etc.; overloading of operators such as >>, << etc., Type Conversions: Basic type to class type, Class type to basic type, one class type to another class type, Inheritance: Single Inheritance, Multiple Inheritance, Hierarchical Inheritance, Multilevel Inheritance and Hybrid inheritance, Constructors in Derived classes, Polymorphism: Run time polymorphism- Virtual functions, Console oriented I/O operations: using IOs class functions and flags, Manipulators, User-defined output functions, File Processing: Sequential files, Random Files, Accessing files using class objects, Updating a file, Templates: Function Templates, Class Templates, Error Handling.

JAVA programming: Simple programs in JAVA

DBMS: Development of data base using suitable DBMS packages

APC 98201 EXPERIMENTAL PHYSICS-II (0-0-8)

Study of Frequency modulation & demodulation, Measurement of Compressibility of liquids using Ultrasonic diffraction grating, Experiments on the measurement of wavelength of sodium light using Newton's rings & Fresnel's bi-prism methods, Measurement of Ultrasonic velocity in liquids using Ultrasonic Interferometer, Measurement of Dielectric constant of different materials, Experiment on the calculation of Diffusion potential and band gap of P-N junction, Photo-electric effect experiment.

SEMESTER – IX**APC 99101 CONDENSED MATTER PHYSICS (3-1-0)**

Interaction of X-rays with matter, absorption of X-rays. Elastic scattering from a perfect lattice. The reciprocal lattice and its applications to diffraction techniques. The Laue, powder and rotating crystal methods, crystal structure factor and intensity of diffraction maxima. Extinctions due to lattice centering.

Defects in Crystals (Point defects, line defects and planar (stacking) faults). Plastic deformation, X-ray and electron microscopic techniques.

Electronic Properties of Solids:

Electrons in a periodic lattice: Bloch theorem, band theory. Tight-binding, cellular and pseudopotential methods. Fermi surface, de Hass von Alfen effect, cyclotron resonance, magnetoresistance, Giant magnetoresistance, colossal magnetoresistance, Magnetic Resonance, quantum Hall effect.

Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, Spin waves and magnons, Curie-Weiss law for susceptibility, Ferri- and antiferro-magnetic order, Ferro and anti-ferro electric effect. Domains and Bloch-wall energy.

APC 99102 LASERS AND HOLOGRAPHY (3-1-0)

Gaussian beam and its properties, Laser Rate equations, Stability conditions, focal concentric and unstable resonators, Stable Two – Mirror Optical Resonators, Longitudinal and Transverse Modes of Laser Cavity , Mode Selection , Gain in a Regenerative Laser Cavity, Threshold for 3 and 4 level Laser Systems. Mode Locking, Q-switching, Pulse Shortening – Pico second & femtosecond operation, Spectral Narrowing and Stabilization.

Gas Lasers, Solid state lasers, Liquid lasers, Semiconductor lasers, Tunable lasers, Excimer Laser and Free electron laser.

Basics of Holography , Reflection, Rainbow, Colour and Fourier transform holography, theory of in - line and off – axis holography, Speckles and its applications, Holographic interferometry, Non-destructive testing of engineering objects.

APC 99103 NUCLEAR PHY. & SP. THEORY OF RELATIVITY (3-1-0)

Nuclear Physics

Nuclear forces, Exchange forces and tensor forces – Meson theory of nuclear forces – Nucleon – nucleon scattering – Effective range theory – Spin dependence of nuclear forces – Charge independence and charge symmetry of nuclear forces – Isospin formalism – Yukawa interaction.

Liquid drop model, Experimental evidence for shell effects – Shell model – Spin – Orbit coupling – Magic numbers - Angular momenta and parities of nuclear ground states - Qualitative discussion and estimates of transition rates.

Beta decay - Fermi theory of beta decay - Shape of the beta spectrum - Total decay rate – Angular momentum and parity selection rules – Comparative half – lives – Allowed and forbidden transitions - Selection rules – Parity violation, Detection and properties of neutrino – Gamma decay, Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism.

Special Theory of Relativity

Orthogonal transformations, Tensors, Tensor Analysis, Tensor densities, tensor density of Levi-Civita, Generalization to n-dimensional continuum, Metric tensor, Riemannian spaces, Raising and lowering indices, Geodesic lines, Minkowski world and Lorentz transformations, world lines.

Relativistic Mechanics of Mass Points, Lorentz covariance of the new conservation laws, Compton effect, Relativistic analytical mechanics, Relativistic force.

Elements of weather and climate, Stability and vertical motion of air, Horizontal motion of air and water, Pressure gradient forces. Viscous forces. Inertia forces, Reynolds number, Enhanced Greenhouse Effect, Energy balance, a zero-dimensional Greenhouse model, Global climate models.

APC 90801	PROJECT & DISSERTATION	(0-15-0)
APC 90802	VIVA-VOCE ON DISSERTATION	(0-0-0)
APC 90501	COMPREHENSIVE VIVA	(0-0-0)