UG (BOS-2018)

Prescribed Open Elective subjects to Programme of UG

SN	Semester	Designation of open-elective in study scheme	Subject code	Title of open elective subjects offered by Department of Physics
1.	5th	Open elective-1	OPPH-611	Analytical Mechanics
			OPPH-612	Statistical Physics and thermodynamics
		Open elective-2	OPPH-613	Materials science
2.	6th	Open elective-3	OPPH-621	Plasma and its applications
		Open elective-4	OPPH-622	Radiation biophysics
3.	7th	Open elective-5	OPPH-711	Laser and its applications

11/6/18
(M.M.Singh)

11/06/18
Vijay Kumar Sharma

11/6/18
K S Kahlon

R.Dutt
11/06/18

11.6.18
(K.S. Mann)

Deepali
11/6/18

Jagwinder Singh
11/6/18

11/6/18

11/6/18

11.6.18

Open Elective-I **OPPH-611T** **Analytical Mechanics** **LTPC/3003**

Course outcomes:

After successful completion of the course, the students should be able to

CO1: Be able to use appropriate co-ordinate system to solve a given mechanics problem.

CO2: Be able to relate symmetries to conservation laws in physical systems, and apply these concepts to practical situations.

CO3: Solve dynamical problems involving classical particles by using the Lagrangian formulation.

CO4: Understand different aspects of motion of Rigid bodies, and their symmetry axes.

CO5: Understand the concept of Inertial and Non-inertial frames of reference.

CO6: Be able to transform physical quantities in one frame of reference to another.

CO7: Understand and apply the basics Relativistic Mechanics to possible practical situations.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S									S
CO2	S											
CO3			S									S
CO4							S					
CO5	S											
CO6			S									S
CO7	S						M					

C/BOS

Open Elective-1 OPPH-611T Analytical Mechanics LTPC/3003

UNIT-I

Co-ordinate Systems and Conservation Laws for a System of Particles: Cartesian and spherical polar co-ordinate systems, Two- and three-dimensional coordinate systems, area, volume, displacement, and velocity in these systems, solid angle. Centre of mass, linear momentum, angular momentum, torque, potential energy and kinetic energy of a system of particles. Definition of Conservative and Non-conservative systems. Symmetries and conservations laws (qualitative idea only) **12L**

Mechanics of System of Particles: Constraints of motion, generalized coordinates, D'Alembert's Principle, Lagrange's equations from DÁlembert's Principle, Lagrange's velocity-dependent forces and the dissipation function, Applications of Lagrangian formulation. **11L**

UNIT-II

Rigid Body motion and Frames of Reference: Rotational motion, principal moments and Axes, Euler's equations, precession and elementary gyroscope. Inertial and Non-Inertial Frames, Transformation equations for inertial frames inclined to each other, Fictitious forces in a rotating frames of reference, Centrifugal and Coriolis forces due to rotation of earth. **11L**

Relativistic Mechanics: Galilean transformations, Postulates of special theory of relativity Lorentz transformations, Kinematical consequences of Lorentz transformations– length contraction and time dilation, Twin paradox, Transformation of velocities, Simultaneity of relativity, Velocity of light in moving fluid, Relativistic Doppler effect. Variation of mass with velocity, mass-energy equivalence, relativistic momentum & energy. **12L**

Total: 46L

BOOKS:

1. Mechanics, H.S. Hans & S.P. Puri.
2. Mechanics, Berkeley, Vol. I, C. Kittle.
3. Classical Mechanics: H. Goldstein, C. Poole and J. Safko (Pearson Education Asia, New Delhi).
4. Mechanics & Relativity (3rd Edition), Vidwan Singh Soni (PHI Learning, New Delhi, 2013)

C/BOS

Open Elective-1 OPPH-612T Statistical Physics and thermodynamics LTPC/3003

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Understand the basic knowledge about s laser and its applications in various fields, optical fibers.

CO2: Know the conceptual physics and its use in solving the physical problems.

CO3: Apply the principles of physics.

CO4: Describe the physics in his /her words.

CO5: Understand the reasons for physical happenings.

CO/PO Mapping S-strong, M-medium and W-weak indicate the strength of correlation												
COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	W		W			S		W	S
CO2	S	S	S	M	S		M	W		W		M
CO3	S	W	M	W	W	S	S	S	S	M	S	S
CO4	S	S	W		W	M			M	S	W	W
CO5	M	W	S	W			S	M			M	

Open Elective-1 OPPH-612T Statistical Physics and thermodynamics

LTPC/3003

Unit-I

Basic ideas of statistical physics, Scope of statistical physics, Basic ideas about probability, distribution of four distinguishable particles in two compartment of equal size. Concept of macro states, microstates, thermodynamic probability, Effects of constraints on the system, Distribution of n particles in two compartments, Deviation from the state of maximum probability, equilibrium state of dynamic system, Distribution of distinguishable n particles in k compartments of unequal sizes. **11L**

Phase space and its division into elementary cells, Three kinds of statistics. The basic approach in the three statistics, Maxwell Boltzmann (MB) statistics applied to an ideal gas in equilibrium. Experimental verification of Maxwell Boltzmann law of distribution of molecular speeds, Need for quantum statistics-Bose-Einstein (B.E.) statistics, Derivation of Planck's law of radiation, Deduction of Wien's displacement law and Stefan's law from Planck's law, Fermi-Dirac (F.D.) statistics, Comparison of M.B., B.E. and F.D. statistics. **12L**

Unit-II

Statistical definition of entropy, Change of entropy of a system, Additive nature of entropy, Law of increase of entropy, Reversible and irreversible process and their examples. Work done in a reversible process. Examples of increase of entropy in natural processes, Entropy and disorder, Brief review of terms and laws of thermodynamics, Heat death of the universe. **11L**

Derivation of Maxwell's thermos-dynamical relations, Cooling produced by adiabatic stretching, Adiabatic compression, Change of internal energy with volume, specific heat at constant pressure and constant volume, Expression for Cp -Cv , Change of state and Clayperon equation, Thermo-dynamical treatment of Joule-Thomson effect, Use of Joule-Thomson effect, liquefication of helium, Production of very low temperature by adiabatic demagnetization. **12L**

Total: 46L

Text Books:

1. Statistical Physics and Thermodynamics, V.S. Bhatia (Sohan Lal Nagin Chand, Jalandhar)
2. Statistical Physics and Thermodynamics, A.K. Sikri (Pardeep Publication, Jalandhar)
3. Statistical Mechanics: An Introductory Text, Bhattacharjee, J.K. (Allied Pub., Delhi) 2000.
4. Statistical Physics, Bhattacharjee, J.K. (Allied Pub., Delhi) 2000.
5. Statistical Mechanics, B.B. Laud (Macmillan India Ltd), 1981.
6. A Treatise on Heat, M.N. Saha & B.N. Srivastava, (The Indian Press Pvt. Ltd., Allahabad) 1965.

c/BOS

Open Elective-2 OPPH-613T Basic Materials science LTPC/3003

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Understand the basic knowledge about s laser and its applications in various fields, optical fibers.

CO2: Know the conceptual physics and its use in solving the physical problems.

CO3: Apply the principles of physics.

CO4: Describe the physics in his /her words.

CO5: Understand the reasons for physical happenings.

CO/PO Mapping
S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	W		W			S		W	S
CO2	S	S	S	M	S		M	W		W		M
CO3	S	W	M	W	W	S	S	S	S	M	S	S
CO4	S	S	W		W	M			M	S	W	W
CO5	M	W	S	W			S	M			M	

C/BOS

Open Elective-2 OPPH-613T Basic Materials science LTPC/3003

UNIT-A

Elements of crystallography: A brief Introduction to material science Material structure, Space lattices, unit cell, primitive cell, Bravais lattice, Atomic packing factor, Miller indices, directions and planes in crystal lattice (cubic & hexagonal only), Distribution of atoms in lattice planes (in cubic crystal only), Important structures (NaCl, CsCl, diamond and ZnS), Structure determination: x-ray diffraction, neuron and electron diffraction. **7L**

Imperfections in crystals: Point imperfections, Frenkel and Schottky defects and their equilibrium concentration determination, Colour centres, types of colour centres, generation of colour centres, Edge and screw dislocation, Berger vector, Surface and volume defects. **5L**

Band theory of solids: Free electron theory, Concepts of energy bands, Bloch theorem, electron in a periodic field of crystal (the Kronig-Penny Model) and its applications in metal, Distinction between metal, semiconductor and insulator, Effective mass of an electron, Hall effect. **6L**

Nano-materials: Fundamentals of nanomaterials and nanotechnology, Nano particles and Properties of nanomaterials, Synthesis, characterization & Applications of nanomaterials. **5L**

UNIT-B

Dielectric materials: Introduction of dielectric materials, polarisation, Different types of polarization, electronic, ionic, orientational and space charge polarization, polarizability, Clausius-Mossotti relation, temperature and frequency dependence of polarizability, dielectric breakdown, measurement of dielectric properties, dielectric constant, dielectric loss, ferroelectric and piezoelectric materials examples of materials and their applications. **8L**

Magnetic Materials: Terminology and classification of magnetic materials, Types of magnetism (dia, para, ferro, ferri and antiferromagnetism), Theories of para, dia and ferromagnetic materials, Magnetic anisotropy and magnetostriction, magnetic domains, hard and soft magnetic materials, Ferrites and their applications. **7L**

Superconductivity: Introduction, type I & type II superconductors, Meissner's effect and isotope effect, effects of magnetic field, London's equations and penetration depth, specific heat, BCS theory (electron-lattice-electron interaction, cooper pair, coherence length and energy gap), High temperature superconductors, Applications of superconductivity. **8L**

Total: 46L

Recommended Books:

Author	Title
Charles Kittel	Introduction to solid state Physics
MS Vijaya, G Rangarajan	Materials scienece
Raghvan	Materials science
Srinivasan and Srivastava	Materials science and Eng.
Callister JR	Materials science and Engg.: an introduction
Askeland and Phule	The science and engineering of material

C/BOS

Open Elective-3 OPPH-621T Plasma and its applications LTPC/3003

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Understand the basic knowledge about s plasma and its applications in various fields of engineering

CO2: Know the conceptual physics and its use in solving the physical problems.

CO3: Apply the principles of physics.

CO4: Describe the physics in his /her words.

CO5: Understand the reasons for physical happenings.

CO/PO Mapping
S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	W		W			S		W	S
CO2	S	S	S	M	S		M	W		W		M
CO3	S	W	M	W	W	S	S	S	S	M	S	S
CO4	S	S	W		W	M			M	S	W	W
CO5	M	W	S	W			S	M			M	

C/BOS

Open Elective-4 OPPH-622T RADIATION BIOPHYSICS LTPC/3003

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: understand the basic knowledge about various kinds of radiations and aware about radiation hazards.

CO2: know the conceptual physics and its use in solving the physical problems.

CO3: apply the principles of physics.

CO4: describe the physics in his /her words.

CO5: understand the reasons for physical happenings.

CO/PO Mapping S-strong, M-medium and W-weak indicate the strength of correlation												
COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	W		W			S		W	S
CO2	S	S	S	M	S		M	W		W		M
CO3	S	W	M	W	W	S	S	S	S	M	S	S
CO4	S	S	W		W	M			M	S	W	W
CO5	M	W	S	W			S	M			M	

C/BOS

Open Elective-3 OPPH-621T Plasma and its applications LTPC/3003

UNIT-I

Introduction to Plasma: Excitation and ionization in a gas (different methods), Definition of plasma, Basic parameters of plasma, Bulk properties, Quasi-neutrality, Electrostatic Boltzman's equation, Plasma sheaths, The plasma frequency, Saha equation, Debye shielding and skin depth, Cold and hot plasma, Magnetized plasmas, Plasma confinement, Radiation plasma, Arc Plasma, Fully ionized plasma **8L**

Charged particle motion: Particle description of plasma, Motion of charged particles in electric and magnetic fields, Motion of charged particles in inhomogeneous magnetic field, Magnetic mirror confinement, Qualitative idea about motion of an electron in a time varying electric field and in a crossed radio frequency and magnetic field. **8L**

Plasma oscillations: Theory of simple oscillations, Electron oscillations in a plasma, Electronic oscillation along with motion of ions, Derivation of plasma oscillations using Maxwell's equations, Ion oscillations and waves, Landau damping, Propagation of e.m. waves in plasma containing a magnetic field. **7L**

UNIT-II

Plasma Diagnostic Techniques: Single probe method, Double probe method, Use of probe technique for measurement of plasma parameters, Qualitative ideas about other methods of plasma diagnostics viz., Microwave method, spectroscopic method, laser as a tool for plasma diagnostics, X-ray diagnostics and acoustic method. **8L**

Plasma applications:

i) Source of power (MHD generator and Controlled thermonuclear fusion)
ii) Generation of microwaves utilizing high density plasma
iii) Concept of plasma propulsion and its applications
iv) Material processing with plasma arcs, plasma processing and fabrication (ion implantation in solids, plasma deposition and etching, paint spraying)
v) Plasma displays, plasma diode and plasma lighting devices/torches
vi) Plasma chemistry, insulating dielectrics and breakdown
vii) Pollution control (thermal, non-thermal, electrostatic precipitation, corona) **15L**

Total: 46L

BOOKS:

1. F.F. Chen: *Introduction to Plasma Physics and Controlled Fusion*, Vol.1, Plasma Physics. 2nd Edition, Plenum Press 1984.
2. J. R. Roth : *Industrial Plasma Engineering*, Vol.1, Principles. IOP Publishing, Ltd 1995.
3. S.N.Sen: *Plasma Physics, Plasma state of matter*, Pragati Prakashan, Meerut, second edition, 1996.
4. Brian Chapman, *Glow Discharge Processes,* John Wiley & Sons, 1980.

C/BOS

Open Elective-4 OPPH-622T RADIATION BIOPHYSICS LTPC/3003

UNIT-I

Atomic and nuclear radiations: Introduction, continuous and characteristic x-rays, Auger electrons, alpha, beta and gamma rays, internal conversion, orbital electron capture, positron decay. Radioactive decay, exponential decay, specific activity, serial radioactive decay- secular, transient and no equilibriums. **5L**

Interaction of radiation with matter Introduction, interaction cross section and its units, Interactions of photons with matter -photoelectric effect, Compton effect, pair production, photonuclear reaction, attenuation and absorption coefficients. Interaction of charged particles with matter (qualitative description), range, straggling, stopping power, inelastic, elastic and radiative collisions. classification of neutrons, neutron interactions. **6L**

Radiation dosimetry: Exposure, absorption of energy, relative biological effectiveness, radiation absorbed dose, dose equivalent, gray, sieverts, particle fluence, kerma. Radiation exposure from natural background and other sources. **4L**

Radiation chemistry: Introduction, Stochastic energy transfer; radiation chemistry of water-radiolysis, radical chemistry, chemical stage; G-value, role of scavengers, Fricke dosimeter and model, direct and indirect actions; recombination, restitution and repair; macromolecular target in the cell, reactions with DNA; chain scission in DNA, chromatin structure, radiation damage of DNA, Repair of DNA-excision & error-prone repairs, repair of double strand breaks. **8L**

UNIT-II

Theories and models for cell survival: Introduction, Clonogenic survival, Lea's target theory model, biological survival curves, target theory model-general survival equation, single hit model, multitarget-single hit survival-properties, quasi-threshold dose; molecular model for cell death- role of enzymatic repair, molecular theory of radiation action, theory of dual radiation action, Repair-Misrepair model of cell survival, Potentially lethal model. **10L**

Survival curve and its significance: Introduction, technique of Clonogenic survival curve, characteristics of mammalian cell survival curve, repair of sub-lethal and potentially lethal damage, cell survival and cell age, radiation induced cell progression delay. Role of water and oxygen in modifying radiation response. **7L**

Non-stochastic and stochastic effects of radiation: Non-stochastic verses stochastic effects, Non-stochastic late effects on gastrointestinal tract, skin, liver, kidneys, lung, central nervous system, eye. Stochastic effects - radiation carcinogenesis. Genetic effects - structural changes in chromosomes, gene mutations. **6L**

Total: 46L

Recommended Books:

1. Radiation biophysics, E.L. Alpen, Academic Press
2. An introduction to radiation protection, A. Martin and S.A. Harbison
3. Physics for radiation protection, J. E. Martin, Wiley-VCH Verlag GmbH & Co.
4. Atoms, radiation and radiation protection, J. E. Turner, Wiley-VCH Verlag GmbH & Co

c/ BOS

Open Elective-5 OPPH-711T LASER AND ITS APPLICATIONS LTPC/3003

Course Outcomes:

After successful completion of the course, the students should be able to

CO1: Understand the basic knowledge about s laser and its applications in various fields, optical fibers.

CO2: Know the conceptual physics and its use in solving the physical problems.

CO3: Apply the principles of physics.

CO4: Describe the physics in his /her words.

CO5: Understand the reasons for physical happenings.

CO/PO Mapping
S-strong, M-medium and W-weak indicate the strength of correlation

COs	Programme outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	W	W	W		W			S		W	S
CO2	S	S	S	M	S		M	W		W		M
CO3	S	W	M	W	W	S	S	S	S	M	S	S
CO4	S	S	W		W	M			M	S	W	W
CO5	M	W	S	W			S	M		.	M	

Open Elective-5 OPPH-711T LASER AND ITS APPLICATIONS LTPC/3003

UNIT- I

LASER: Introduction, Einstein coefficient and light Applications, Laser rate equations, Optical resonators, The laser output, Q-switching, mode locking properties, Ruby, helium-neon, Solid state, carbon di-oxide, Dye and semiconductor lasers, free electron Lasers and cyclotron resonance masters. **12L**

HOLOGRAPHY: Introduction, Recording and reconstruction of Holograms, Type of Holograms, Holographic recording materials, holographic storage of information and Data processing, Holographic Interferometry and its application. **11L**

UNIT-II

OPTICAL FIBER COMMUNICATION: Introduction, Optical fibre Numerical Aperture, coherent bundle, fibre-optic communication system, Losses in optical fibres (Attenuation & Dispersion) Pulse dispersion in step index fibres, Graded index fibres, some general consideration: First and Second generation fibre optic communication system, Single mode fibres and the third Generation Optical communication system operation at 1.5 um wavelength, Fourth Generation optical fibres, applications fibre optic system, Advantage of fibre optic system. **12L**

APPLICATIONS OF LASERS & OPTICAL FIBRES: Introduction, Material processing, Welding, Cutting, Drilling, Hardening, Micro machining and other application, Metrology, Non-destructive testing, Pollution Detection, Laser tracking LIDAR, Precision length measurement, Velocity measurement, Recent advances, optical interconnections for integrated circuits, optical computing, Star war. **11L**

Total: 46L

RECOMMENDED BOOKS:

Lasers – Theory & applications K Thyagarajan & A K Ghatak MacMilllan India Ltd

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