

Open Elective-1 OEPH-611A 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) **9Hrs**

Mechanics of System of Particles: Constraints of motion, generalized coordinates, D'Alembert's Principle, Lagrange's equations from D'Alembert's Principle, Lagrange's velocity-dependent forces and the dissipation function, Applications of Lagrangian formulation. **9Hrs**

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. **9Hrs**

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. **9Hrs**

Total: 36Hrs

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)
5. Classical Mechanics by Gupta, Kumar, Sharma (Pragati Prakashan, MEERUT).

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Department of Physics
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Course Outcomes:

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

CO1: Understand the basic knowledge about laser and optical fibre with their applications in various fields.-


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	S

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Open Elective-1 OEPH-611B 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 compartments each 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 n distinguishable particles in k compartments of unequal sizes. **10Hrs**

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, Derivation of Planck's law of radiation, Deduction of Wien's displacement law and Stefan's law from Planck's law, Bose-Einstein (B-E) and Fermi-Dirac (F-D) statistics, Comparison of M-B, B-E and F-D statistical distributions. **10Hrs**

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. **8hrs**

Derivation of Maxwell's thermo-dynamical relations, Cooling produced by adiabatic stretching, Adiabatic compression, Change of internal energy with volume, specific heat at constant pressure and at constant volume, Expression for $C_p - C_v$, Change of state and Clayperon equation, Thermo-dynamical treatment of Joule-Thomson effect, Use of Joule-Thomson effect, liquefaction of helium, Production of very low temperature by adiabatic demagnetization. **8Hrs**

Total: 36hrs**Text Books:**

1. Statistical Physics and Thermodynamics, V.S. Bhatia, Publisher- Shoban Lal Nagin Chand & Co., Jalandhar, 1996.
2. Statistical Physics and Thermodynamics, A.K. Sikri, Pardeep Publication, Jalandhar, 2005.
3. Statistical Mechanics, B.B. Laud (Macmillan India Ltd), 1981.
4. A Treatise on Heat, M.N. Saha & B.N. Srivastava, (The Indian Press Pvt. Ltd., Allahabad) 1965.

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Open Elective-2 OEPH-612T Basic Materials Science LTPC/3003

Course Outcomes:

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

CO1: Understand common crystal structure and describe their symmetries.

CO2: Understand the concept of various phases of solid materials.

CO3: Understand the imperfection in solids and its effect on materials properties.

CO4: To analysis the thermal properties of materials and properties of composites.

CO5: Describe nanomaterials based on their dimensionality.

CO/PO Mapping												
S-strong, M-medium and W-weak indicate the strength of correlation												
COs	Programme outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO 1	S	W	W	W		W			S		W	S
CO 2	S	S	S	M	S		M	W		W		M
CO 3	S	W	M	W	W	S	S	S	S	M	S	S
CO 4	S	S	W		W	M			M	S	W	W
CO 5	M	W	S	W			S	M			M	

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Open Elective-2 OEPH-612T 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, neutron and electron diffraction. **8Hrs**

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. **4Hrs**

Equilibrium diagrams and phase transformations: Phase rule, Hume-Rothery rules for solid solutions, cooling curves for solidification of pure metals and alloys, unary system, binary system, Invariant reactions in binary system, iron-carbon equilibrium diagram, Nucleation and growth of crystal. (Homogeneous case only), application of phase diagrams. **6Hrs**

UNIT-B

Thermal properties of materials: Introduction, theory of specific heat of solids, classical theory (Dulong and Petit law), Einstein theory of specific heat, Debye's theory, The concepts of phonons, Lattice vibrations (one dimensional lattice), Thermal conductivity, thermal expansion, thermoelectric effect **6Hrs**

Composites: Introduction, general characteristics, particle-reinforced composites, Large-Particle Composites, Dispersion-Strengthened Composites, fiber-reinforced composites, Influence of Fiber Length, Influence of Fiber Orientation and Concentration, The Fiber Phase, The Matrix Phase, Polymer-Matrix Composites, Metal-Matrix Composites, Ceramic-Matrix Composites, Carbon-Carbon Composites, Hybrid Composites, Processing of Fiber-Reinforced Composites **8Hrs**

Nano-materials: Fundamentals of nanomaterials and nanotechnology, Nano particles and Properties of nanomaterials, Synthesis, characterization & Applications of nanomaterials. **4Hrs**

Total: 36Hrs**Recommended Books:****Author**

Charles Kittel
MS Vijaya, G Rangarajan
Raghvan
Srinivasan and Srivastava
Callister JR
Askeland and Phule

Title

Introduction to solid state Physics
Materials science
Materials science
Materials science and Eng.
Materials science and Engg.: an introduction
The science and engineering of material

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Open Elective-3 OEPH-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 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	

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Open Elective-3 OEPH-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. **8Hrs**

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. **8Hrs**

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. **8Hrs**

UNIT-II

Plasma Diagnostic Techniques: Use of probe technique for measurement of plasma parameters, Single probe method, Double probe method, 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. **6Hrs**

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) 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)

6Hrs

Total: 36Hrs

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.

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Open Elective-4 OEPH-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	

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

Course Outcomes:

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

CO1: employ 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/M/W/N indicates strength of correlation)												S-Strong, M-Medium, W-Weak, N-None	
COs	Programme outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	S	W	W	W	N	W		N	S	S	W	S	
CO2	S	S	S	M	S	N	M	N	S	W	N	M	
CO3	S	W	M	W	W	S	S	N	S	M	S	S	
CO4	S	S	W	N	W	M		N	S	S	W	W	
CO5	M	W	S	W	N	N	M	N	S	W	M	S	

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Open Elective-5 OEPH-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.

8Hrs

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.

8Hrs**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 μm wavelength, Fourth Generation optical fibres, applications fibre optic system, Advantage of fibre optic system.

10Hrs

APPLICATIONS OF LASERS & OPTICAL FIBRES: Introduction, Material processing, Welding, Cutting, Drilling, Hardening, Micro machining, 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.

10Hrs**Total: 36Hrs****RECOMMENDED BOOKS:**

Lasers – Theory & applications

K Thyagarajan & A K Ghatak MacMillan India Ltd

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