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Syllabus 2023-24
Panjab University

BSc
(PHYSICS)

FOURTH SEMESTER

SCO 80-81, Sec.15D, Chandigarh

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PHYSICS**SEMESTER – IV****Papers, marks and teaching hours allocation:**

Paper A	:	Statistical Physics and Thermodynamics – II	Total Teaching hrs. 30
Paper B	:	Optics and Lasers –II	Total Teaching hrs. 30
Paper C	:	Quantum Physics-II	Total Teaching hrs. 30
		Physics Practicals	Total Teaching hrs. 45

Paper A : STATISTICAL PHYSICS AND THERMODYNAMICS-II (30 Hrs.)**UNIT-I**

Statistical definition of entropy, change of entropy of a system, additive nature of entropy, law of increase of entropy, reversible and irreversible processes with examples. Work done in a reversible process. Examples of increase of entropy in natural processes. Entropy and disorder.

Brief review of the terms and Laws of Thermodynamics, Carnot's Cycle. Entropy changes in Carnot's Cycle. Applications of thermodynamics to thermoelectric effect, change of entropy along a reversible path in a P.V. diagram, entropy of a perfect gas. Equation of state of ideal gas from simple statistical consideration. Heat death of the universe.

UNIT-II

Derivation of Maxwell's thermodynamical relations and applications, cooling produced by adiabatic stretching, adiabatic compression, change of internal energy with volume. Expression for $(C_p - C_v)$, change of state and Clayperon Equation. Thermodynamical treatment of Joule-Thomson effect. Use of Joule-Thomson effect for liquification of helium. Production of very low temperature by adiabatic demagnetisation.

Books Suggested :***Essential Readings:***

1. "Statistical Physics and Thermodynamics", V.S. Bhatia, (Shoban Lal Nagin Chand, Jalandhar)
2. "A Treatise on Heat" Saha and Srivastava (Indian Press, Ahmedabad, 1972.)

Further Readings :

1. *Thermal Physics* by C. Kittel & H. Kroemer, CBS Pub., 1987
2. *Thermal Physics*, S.C. Garg, R.M. Bansal, and C.K. Ghosh, TMH, 2000.

Paper-B : OPTICS AND LASERS-II**(30 Hrs.)****UNIT-I***Laser Fundamentals :*

Interaction of light with matter : Absorption, spontaneous emission, stimulated emission, Wave mechanical explanation, Properties of Spectral Lines, Temporal and spatial coherence, Characteristics of stimulated emission, Einstein coefficients and their relations, Light amplification and threshold condition, Population inversion, Kinetics of optical absorption (qualitative account only), Qualitative account of Collisional broadening, Doppler broadening & Natural broadening, Mechanism of Luminescence.

Lasing action, Components of Laser, Elementary theory of optical cavity, longitudinal and transverse modes, Principal pumping schemes, Three level and four level laser schemes.

UNIT-II

Laser Systems : Types of lasers, Ruby and Nd : YAG lasers. He-Ne, Dye and CO₂ lasers – construction, mode of creating population inversion and output characteristics.

Applications of lasers—a general outline, Holography. Principle, recording of hologram and reconstruction of image.

Fiber Optics : Photonics, Optical fibre, Construction, Numerical aperture, acceptance angle, skip distance, Step index fibre – single mode and multimode, Graded index fibre, Losses in optical fibre, Material losses and Rayleigh scattering, bending losses, Intermodal and intramodal dispersion.

Splicing techniques, Optical fibre based communication system, Medical applications.

Books Suggested :***Essential Readings :***

1. *Laser Fundamentals*, W.T. Silfvast, Foundation Books.
2. *Lasers and Non-linear Optics*, B.B. Laud, Wiley Eastern Limited.
3. *A text book of Optics*, Subrahmanyam N., Lal B. and Avadhanulu, M. N., S. Chand & Co., 2012.
4. *Optical Fiber Communication*, Keiser, MH.

Further Readings :

1. *Lasers*, Svelto Pergmon.

Paper-C : QUANTUM PHYSICS-II**(30 Hrs.)****UNIT-I**

Radiative transitions, selection rules and life times,
Spectrum of hydrogen atom.

Normal Zeeman effect and experiment, Degeneracy of H-atom energy levels, fine structure, Electron angular momentum, Larmor's frequency, electron spin angular momentum, Exclusion principle, Stern-Gerlach experiment, spin-orbit coupling, electron magnetic moment, total angular momentum, Hyperfine structure, examples of one electron systems, Anomalous Zeeman effect, Lande-g factor (sodium D-lines). Paschen-Back Effect, Stark Effect.

(Chapters 6 & 7 of Book 1, Chapters 8-10 of Book 2)

UNIT-II

Symmetric and Antisymmetric wave functions, exclusion principle, Many electron atoms, Slater determinant, Electronic configurations, Hund's rule, Spin-Orbit coupling, L-S coupling, J-J couplings, term symbols. Atomic spectra of H, Na, He and Hg, selection rules.

X-ray spectra, nomenclature, Selection rules, Mosley law, Auger effect.

Molecular bonding, H_2^+ ion and H_2 molecules, Complex molecules, molecular spectra, selection rules, symmetric structures, rotational vibrational levels and spectra of diatomic molecules, vibration-rotation spectra, electronic spectra of molecules, Franck Condon principle, fluorescence and phosphorescence, Raman Effect, Magnetic resonance experiments.

(Chapters 7 & 8 of Book 1, Chapter 12 of Book 2)

Books Suggested :**Essential Readings :**

1. *Concepts of Modern Physics*, A. Beiser, S. Mahajan and S. R. Choudhary, Tata McGraw Hill, 6th Edition.
2. *Quantum Physics of Atoms, Molecular*, R. Eisberg & R. Resnick, Second Edition, John Wiley, 2002.
3. *Physics for Degree Students*, C.L. Arora and P.S. Hemne, S.Chand & Co., 2014.
4. *Elements of Modern Physics*, S.H. Patil, McGraw Hill, 1998.

Further Readings :

1. *Fundamentals of Molecular Spectroscopy*, C.N . Banwell, T.M.H., 1972
2. *Atomic and Molecular Spectra*, Rajkumar (Kedarnath Ramnath Prakashan, Meerut).
3. *Atomic Spectra*, H.G. Kuhn, Academic Press, N.Y.

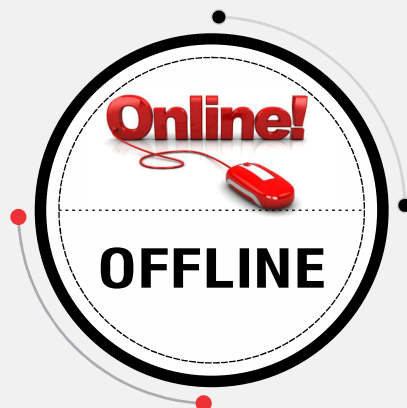
PHYSICS PRACTICALS

The Practical examination will be held along with the fourth semester examinations. General Guidelines for Physics Practical Examinations and syllabus is given in syllabus for Semester III.

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