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Syllabus 2023-24
Panjab University

BSc
(PHYSICS)
THIRD SEMESTER

SCO 80-81, Sec.15D, Chandigarh
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PHYSICS

B.Sc. (GENERAL) SECOND YEAR (3rd and 4th Semester) EXAMINATION, 2023-2024

General Instructions for teachers, students and paper setters:

1. There will be three papers of theory and one laboratory (practical course). Each of the theory papers is allocated 25 marks including 3(three) marks for the Internal Assessment. The Practical examination is of 25 marks including 3 (three) marks for the Internal assessment. The exams will be conducted every semester.

2. The number of lectures per week will be three for each theory paper and six for practicals.

3. The examination time for each theory paper as well as practical paper will be three hours.

4. Each theory paper will consist of seven questions comprising of three sections. First two sections will comprise of three questions from each of Units I and II of syllabus, and the third section will comprise of one compulsory question of ten short answer type parts covering whole syllabus. The question paper will be set for 44 marks - All the questions in first and second sections will carry 9 (nine) marks each and the compulsory question will carry 8 marks. Student will attempt two questions from each of the first two sections and any eight parts of the compulsory questions. After evaluation of the answer books out of 44 marks, the marks will be given out of 22 marks.

5. The numerical problems/exercises in the question paper should be 25-30%.

6. The use of Non-programmable calculators will be allowed (paper setter should explicitly mention this in the question paper) in the examination centre but these will not be provided by the University/College. Mobile phones and pages are not allowed in the examination hall.

7. External examiners will be sent for Practical examinations.

PHYSICS

SEMESTER-III

Papers, marks and teaching hours allocation:

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

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

UNIT-I

Basic ideas of Statistical Physics, Scope of Statistical Physics, basic ideas about probability, distribution of four distinguishable particles in two compartments of equal size. Concept of macrostates, 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.

UNIT-II

Phase space and its division into elementary cells, three kinds of statistics. The basic approach in the three statistics. Maxwell-Boltzman statistics applied to an ideal gas in equilibrium, experimental verification of Maxwell-Boltzman's law of distribution of molecular speeds.
Need of quantum statistics--B.E. statistics, derivation of Planck's law of radiation, deduction of Wien's displacement law and Stefan's law from Planck's law, F.D. statistics, Comparison of M.B., B.E. and F.D. statistics.

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-I **(30 Hrs.)**

UNIT-I

Interference : Concept of coherence, spatial and temporal coherence, coherence time, coherence length, area of coherence. Conditions for observing interference fringes. Interference by wavefront division and amplitude division. Young's double slit experiment. Lloyd's mirror and Fresnel's biprism, phase change on reflection. Newton's rings,Michelson interferometer—working, principle and nature of fringes. Interference in thin films, Role of interference in anti-reflection. Multiple beam interference, Fabry-Perot interferometer, nature of fringes, finesse.

UNIT-II

Diffraction : Huygen-Fresnal theory half period zones, zone plates. Distinction between Fresnel and Fraunhofer diffraction. Fraunhofer diffraction due to single slit and intensity distribution,double slits & multiple slits(qualitative). Fraunhofer diffraction at rectangular (qualitative discussion)and circular apertures. Effects of diffraction in optical imaging, resolving power of microscope and telescope, diffraction grating, its use as a spectroscopic element, resolving power, Moire's fringes.

Polarization : Concept and analytical treatment of unpolarised, plane polarized and elliptically polarized light. Double refraction, Nicol prism, sheet polarisers, retardation plates. Production and analysis of polarized light (quarter and half wave plates).

Books Suggested :

Essential Readings:

1. *Optics*, Jenkins and White, McGraw Hill.
2. *Optics*, Ajoy Ghatak, McMillan India.
3. *Physics for Degree Students,* C. L. Arora and P .S. Hemne, S. Chand & Co., 2014.

Further Readings:

1. *Optics*, Born and Wolf, Pergamon.

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

UNIT-I

Formalism of Wave Mechanics :

(i) Plancks's formula of Black body radiation and energy quantization,
Wave-particle duality – Photoelectric effect, X-ray diffraction, Compton effect, Pair production, Photon and gravity.
De Brogile waves, wave packet, Phase velocity and Group velocity, Electron microscope, Particle in a box, Particle diffraction, Davisson-Germer experiment, Interferferometry with particles.
Uncertainty principle with illustrations, Principle of complementarity. (Chapters 2 and 3 of book 1 or Chapters 1-3 of book 2)

(ii) Quantum mechanics, Wave equation, Plausible arguments leading to time-dependent Schrodinger equations, Born's interpretation of Wave function, complex character, continuity and boundary conditions, probability interpretation, normalization, Probabilty current, Probability conservation equation, Principle of superposition.

(iii) Fundamental postulates of quantum mechanics. Eigenvalues and eigenfunctions. Operator formalism, Position, momentum and energy operators, expectation values, Ehrenfest theorem, Hermitian operators.

(Chapter 5 of book 1 and book 2)

UNIT-II

Problems in One and Three Dimensions :

(a) Steady-state Schrodinger equation, Appliction to stationary states for one dimension, Potential step. potential barrier, Tunnel effect examples, Scanning Tunneling microscope, rectangular potential well, Linear harmonic oscillator.

(Chapter 5 of book 1 and book 2)

(ii) Schrödinger equation for spherically symmetric potential, spherical harmonics, hydrogen atom energy levels and eigenfunctions, Principal, Orbital and Magnetic quantum numbers, Electron probability density.

(Chapter 6 of book 1 and book 2)

Books Suggested :

Essential Readings :

1. *Concept of Modern Physics, A. Beiser, S. Mahajan and S. R. Choudhury, 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*

Further Readings :

1. *Modern Physics,* J. Bernstein, P.M. Fishbane, S.G. Gasiorowicz, Pearson, 2000.
2. *Elements of Modern Physics*, S.H. Patil, McGraw Hill, 1998.
3. *Quantum Mechanics*, E. Merzbacaher, II Ed., John Wiley.

PHYSICS PRACTICALS

The students are required to perform all the Nine experiments from each of the Units I and Unit II .The Practical examination will be held along with the fourth semester examination.

The aim of the project work is to develop the scientific and technical temper in the students and as such it may consist of development of a laboratory experiment,fabrication of a device or electronic circuit etc. The student will prepare a project report of about 10 pages. Assessment of the project work will be done on the basis of the effort put in the execution of the project, report prepared and viva-voce.

General Guidelines for Physics Practical Examinations :

Total : 50 marks

1. The distribution of marks is as follows :

(i) One full experiment out of section–A requiring the student to take some data, analyse it and draw conclusions. (Candidates are expected to state their results with limits of error).	20
(ii) One exercise based on experiment or Computer Programming from the Unit assigned to the student for the semester	7
(iii) Viva-Voce and Record (Practical file)	10
(iv) Project	8
(v) Internal Assessment	5

Note for Examiners :

2. The marks scored under each head must be clearly written on the answer sheet.
3. There will be one session of 3 hours duration. The paper will have two sections. Section–A will consist of 4 experiments from each of Units I and Unit II, out of which an examinee will mark 3 experiments from either of units and one of these is to be allotted by the external examiner.
4. Section–B will consist of exercises/computer based activities which will be set by the external examiner on the spot. The length of the exercises should be such that any of these could be completed in one hour.
5. The examiner should take care that the experiment allotted to an examinee from section-A and exercise allotted from section–B are not directly related to each other.
6. Number of candidates in a group for practical examination should not exceed **20**.
7. In a single group, no experiment be allotted to more than three examinees in the group.

List of Experiments :

UNIT-I

A. Statistical Physics and Thermodynamics :

I. To study adiabatic expansion of a gas.

II. To measure thermal expansion of crystal using interference fringes.

III. To measure thermal conductivity in poor conductor by Lee's method.

IV. Thermo emf calibration, comparison.

V. Total radiation law, temperature dependence of radiation.

VI. To study Probability distribution using coloured dice, coins.

B. Optics and Lasers :

VII. To determine the refractive index of a liquid using spectrometer.

VIII. To determine the Cauchy's constants.

IX. To study the refractive index of a doubly refracting prism.

X. Study of rotation of plane of polarization with a polarimeter.

XI. To determine the wave length of a given light using biprism.

Exercises :

1. To measure the thermo e.m.f.
2. To determine the heating efficiency of an electric kettle with varying voltages.
3. To measure the angle of rotation of plane of polarization for the given liquid.
4. To determine the least count and setup the spectrometer for minimum deviation position of the prism.

Computer Based Activities : Elementary C language programs.

1. Motion of particle in a central force field.
2. Calculation of days between two dates of a year.
3. To check if triangle exists and the type of the triangle.

UNIT-II

C. Optics and Lasers :

I. To determine the wave length and dispersive power using plane diffraction grating (use Hg source).

II. To determine the resolving power of a telescope.

III. To determine the resolving power of a grating.

IV. Set up Newton's rings to determine wave length of sodium light.

V. To measure an inaccessible height using sextant.

VI. To determine the principal points of a lens system.

VII. To determine the divergence and wave length of a given laser source.

D. Quantum Physics:

VIII. To study the Photoelectric effect and determine the value of Planck's constant.

IX. To study the gas discharge spectrum of hydrogen.

X. To study the absorption spectra of iodine vapours.

XI. To determine the ionization potential of mercury.

Exercises :

1. To measure the diameter of Newton's rings.
2. Study of variation of light intensity using photovoltaic cell/inverse square law.
3. To determine the angle of wedge using interference method.
4. To measure the angle of elevation of a tall building.

Computer Based Activities : Elementary C language programs.

1. To find the sum of the sine and cosine series and print out the curve.
2. To find Sum and Product of Matrices
3. Motion of a projectile using computer simulation.

Text and Reference Books :

1. *A Laboratory Manual of Physics for Undergraduate Classes,* D.P. Khandelwal.
2. *B.Sc. Practical Physics, C.L.* Arora (S. Chand) & Co. (2014)
3. *Numerical Analysis* by C. Dixon.
4. *Programming with C, Schaum series* by Byron Gottfried & Jitender Chhabra.
