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Syllabus 2023-24
Panjab University

BSc
(PHYSICS)
FIFTH SEMESTER

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PHYSICS

B.Sc. (GENERAL) THIRD YEAR (5th and 6th Semester) EXAMINATION, 2023-24

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 50 marks including 5 (Five) marks for the Internal assessment and will be held along with the sixth semester examination.
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 will be three hours and it will be four hours for practicals.
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 question. **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 setters should explicitly mention this on the question paper) in the examination centre but these will not be provided by the University/College. Mobile phones and pagers are not allowed in the examination hall.

PHYSICS

SEMESTER – V

Papers, marks and teaching hours allocation:

Paper A :	Condensed Matter Physics - I	Total Teaching hours 30
Paper B :	Electronics and Solid State Devices - I	Total Teaching hours 30
Paper C :	Nuclear & Particle Physics - I	Total Teaching hours 30
	Physics Practicals	Total Teaching hours 45

Paper A : CONDENSED MATTER PHYSICS - I (30 Hrs.)

UNIT-I

Crystal structure: Symmetry operations for a two dimensional crystal. Two dimensional Bravais lattices, Three dimensional Bravais lattices, Basic primitive cells, Crystal planes and Miller indices, Diamond and NaCl structure. Crystal diffraction : Bragg's Law, Determination of crystal structure, Laue equations, Reciprocal lattices of SC, BCC and FCC, Bragg's law in reciprocal lattice, Brillouin zones and its derivation in two dimensions, structure factor and atomic form factor.

UNIT-II

Band Theory of solids, periodic potential and Bloch theorem, Kronig-Penney model, band gaps, band structures in conductors, direct and indirect semiconductors and insulators.
Free electron theory of metals, effective mass, drift current, mobility and conductivity (carrier concentration and mobility of carriers) and their variation with temperature in semi-conductors, Fermi level positions in intrinsic and extrinsic semiconductors, Wiedemann-Franz law, Hall effect in metals and semiconductors.

Recommended Books :

Essential Readings :

1. *Introduction to Solid State Physics, C.* Kittel, Wiley Eastern
2. *Elements of Modern Physics,S.*H. Patil, Tata McGraw Hill, 1985.
3. *Solid State Physics, 6th Edition, S.O.* Pillai, *New Age International Publishers.*
4. *Physics for Degree Students*, C.L. Arora and P.S. Hemne, S. Chand & Co., 2014.

Further Readings :

1. *Elements of Solid State Physics,* 2nd Edition, J.P. Srivastava, Prentice Hall.
2. *Elementary Solid State Physics,* M. Ali Omar, Pearson.
3. *Crystallography for Solid State Physics,* A.R. Verma, O.N. Srivastava, Wiley Eastern.

Paper-B : ELECTRONICS AND SOLID STATE DEVICES - I (30 Hrs.)

UNIT-I

Concepts of current and voltage sources, Thevenin's theorem, Norton's theorem, Source conversion.
CRO, Block diagram, construction and principle of working, Use of CRO for frequency, time period, special features of dual trace, phase measurements.

Energy band diagrams in semiconductors, Direct and indirect semiconductors, Formula to calculate Position of Fermi level in p and n semiconductors, Barrier formation, energy band diagram of p-n junction, Formula for Depletion width, Qualitative ides of current flow mechanism in forward and reverse biased diode, v-i characteristics, static and dynamic resistance, Depletion and diffusion capacitance, zener diode, LED, photodiode and solar cell.

(Book 1, Book 3)

UNIT-II

Diode circuits, Clipping circuits, Rectification: half wave, full wave and bridge rectifiers, filter circuits (C, LC and π filters), rectification efficiency and ripple factor in LC filter, voltage regulation circuit using zener diode, voltage multiplier circuits.
Bipolar Junction transistors : Structure and working, different currents in transistor, switching action. Characteristics of CB, CE and CC configurations, Active, cutoff and saturation regions.
Load line analysis of transistors, Q-point, Transistor biasing and stabilization of operating point, fixed bias, collector to base bias, bias circuit with emitter resistor, voltage divider biasing circuit.
Working ans analysis of CE amplifier using h-parameters, current, voltage and power gain, input and output impedance. Class A, B and C amplifiers.

(Book 1, Book 2)

Recommended Books :

Essential Readings :

1. Electronic Devices and Circuit Theory, 7th Ed., R. Boylestad, L. Nashelsky, Prentice Hall Inc
2. *Electronic Principles, A.P.* Malvino, and D.J. Bates, *7th ed.* McGraw Hill
3. *Solid State Electronic Devices,* 6th Ed., Ben G. Streetman and S. Banerjee, Eastern Economy Edition.

Further Readings :

1. *Basic Electronics,* 5th Edition, B.L. Thareja, S. Chand.
2. *Basic Electronics and Linear Circuits, N.N.* Bhargave, D.C. Kulshreshtha, and S.C. Gupta,Tata Mc Graw Hill.
3. *Foundations of Electronics, D.* Chatopadhyay, P.C. Rakshit, B. Saha, and N.N. Purkit, New Age International

Paper-C : NUCLEAR AND PARTICLE PHYSICS - I **(60 Hrs.)**

UNIT-I

General properties of Nuclei : Constituents of nucleus and their intrinsic properties, Quantitative facts about nuclear size, mass, density, binding energy and its variation with mass number, Wave mechanical properties of nucleus, angular momentum, parity; magnetic moment and electric moments of the nucleus. properties of nuclear forces and saturation, meson theory of nuclear forces
Nuclear Models : Liquid drop model, semi-empirical mass formula, most stable isobar.
Evidence for nuclear shell structure, Nuclear shell model, concept of mean field.

UNIT-II

Radioactive decay, Units of radioactivity (Ci and Bq), Successive disintegration, Natural radioactivity, Radioactive series, Carbon dating.
Alpha decay, energetic, alpha spectrum, Gamow's theory of alpha decay, Geiger-Nuttal rule.
Beta decay, Qualitative discussion of beta spectrum, Evidence of existence of Neutrino, Conservation of nuclear energy in Beta minus, Beta plus and Electron capture decays.
Gamma-ray emission, selection rules, Internal conversion.

Nuclear Reactions: Types, Concept of compound and direct (pickup and stripping) reactions, Reaction differential and integral cross section, units, conservation laws and kinematics, Q-value equation, Coulomb (Rutherford) scattering cross section and distance of nearest approach.
Energy classification of neutrons, Nuclear fission in reactors, Reactor facilities available in India, Nuclear fusion in stars.

Recommended Books :

Essential Readings:

1. *Concept of Modern Physics,* 6th Ed., A. Beiser, S. Mahajan and S.R. Choudhury, Tata McGraw Hill.
2. *Nuclear Physics, I.* Kaplan,Addition-Wesley, Publishing Company Inc.
3. *Physics for Degree Students*, C.L. Arora and P.S. Hemne, S. Chand & Co., 2014.

Further Readings :

1. *An Introduction to Nuclear Physics, M.R.* Bhiday, and V.A. Joshi, Orient Longman.
2. *Concepts of Nuclear Physics, B.L.* Cohen, Tata McGraw Hill
3. *Fundamentals of Nuclear Physics, J.* Verma, CBS.

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 sixth 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 12.
7. In a single group, no experiment be allotted to more than three examinees in the group.

List of Experiments :

Note : Each student should perform ***at least Nine experiments*** in the laboratory.

UNIT-I

I CONDENSED MATTER PHYSICS:

(i) Measurement of reverse saturation current in p-n junction diode at various temperatures and to find the approximate value of energy gap.
(ii) To draw forward and reverse bias characteristics of a p-n junction diode and draw a load line.
(iii) Study of a diode as a clipping element.
(iv) To measure the magnetic susceptibility of $FeCl_2$ solution by Quincke's method.

II ELECTRONICS AND SOLID STATE DEVICES :

(v) To study the response of RC-circuit to various input voltages (square, sine and triangular).
(vi) To measure the efficiency and ripple factors for (a) Half-wave, (b) Full wave, and (c) Bridge rectifier circuits.
(vii) To study the reduction in the ripples in the rectified output with RC, LC and π-filters.
(viii) To draw the characteristics of a Zener diode and LED using constant current source.
(ix) To study the stabilization of output voltage of a power supply with Zener diode.
(x) To set up an oscillator and study its output on CRO for different V values.
(xi) To study the characteristics of a thermistor and find its parameters.

Exercises :

1. Any one exercise based on the above given experiments.

Computer Based Activities : Elementary C language programs.

1. Print a 2D array in spiral form.
2. To find determinant of a given matrix.
3. To find inverse of a given matrix.
4. To interpolate the data values from the given set.

UNIT-II

I CONDENSED MATTER PHYSICS:

(i) To trace the B-H curves for different materials using CRO and find the magnetic parameters from these.
(ii) To find the conductivity of a given semi-conductor crystal using four probe method.
(iii) To determine the Hall coefficient for a given semiconductor.

II ELECTRONICS AND SOLID STATE DEVICES :

(iv) To measure and plot Common Emitter Characteristics of a transistor (pnp or npn).
(v) To plot Common Base Characteristics and determine h-parameters of a given transistor.
(vi) To draw output and mutual characteristics of an FET and determine its parameters.
(vii) To study the gain of an amplifier at different frequencies and to find band-width and gain-band- width product.

III NUCLEAR PHYSICS :

(viii) To draw the Plateau of a GM counter and find its dead time.

(ix) To study the statistical fluctuations using GM counter.

(x) To study the absorption of beta-particles and determine the end point energy using GM counter. Also determine the absorption co-efficient (for aluminium) from it .

(xi) Verification of Rutherford Scattering experiment-mechanical analogue.

Exercises :

1. Any one exercise based on the above given experiments.

Computer Based Activities : Elementary C language programs.

1. To solve simultaneous equations by elimination method.
2. Fitting a straight line or a simple curve of a given data.
3. Convert a given integer into binary and octal/hexadecimal system and vice versa.

Text and Reference Books :

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

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