

SCHEME
B.Sc. (Physics) Part-III (V and VI Semester)
PROGRAMME CODE: PHYB3PUP
SESSION 2023-24, 2024-25 & 2025-26

Code	Title of Paper	Total Teaching Hours	Max Marks			Examination Time (Hours)
			Total	Ext.	Int.	
SEMESTER -V						
PHYB3501T	Condensed Matter Physics-I	30	40	30	10	03
PHYB3502T	Electronics-I (Electronics and Solid State Devices)	30	40	30	10	03
PHYB3503T	Nuclear and Radiation Physics	30	40	30	10	03
PHYB3504L	Practicals	60	30	22	08	03
SEMESTER -VI						
PHYB3601T	Condensed Matter Physics-II	30	40	30	10	03
PHYB3602T	Electronics-II	30	40	30	10	03
PHYB3603T	Nuclear and Particle Physics	30	40	30	10	03
PHYB3604L	Practicals	60	30	22	08	03

General Instructions

- 1) There will be three papers of theory and one laboratory (practical) course.
- 2) The number of lectures per week will be three for each theory paper.
- 3) The number of lectures per week will be six for practicals.
- 4) The examination time for each theory will be 3 hours.
- 5) The examination time for practical will also be 3 hours.
- 6) The use of non programmable calculator will be allowed in the examination centre but this will not be provided by the University/College.
- 7) Each theory paper will consist of three sections A, B and C. Section C is compulsory
- 8) Use of scientific non programmable calculator is allowed in practicals also.

SECTION A

There will be four questions. Each question will carry five marks. Two questions are to be attempted

SECTION B

There will be four questions. Each question will carry five marks. Two questions are to be attempted.

SECTION C

There will be seven questions of short answer type covering the whole syllabi. Each question will carry two marks. Any five question to be attempted.

SEMESTER V

PHYB3501T: CONDENSED MATTER PHYSICS-I

Maximum Marks: External: 30
Internal: 10
Total: 40

Time Allowed: 3 Hours
Total Teaching Hours: 30
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semesters tests/ internal examination, written assignment/project work etc. and attendance) carries 10 marks, and the final examination at the end of the semester carries 30 marks.

Instruction for the Paper Setter

The question paper will consist of three sections A, B and C. Each of sections A and B will have four questions from respective sections of the syllabus. Section C will have 07 short answer type questions (Candidate is to attempt any five questions), which will cover the entire syllabus uniformly. Each question of sections A and B carry 05 marks. Section C will carry 10 marks.

Instruction for the candidates

- 1) Candidates are required to attempt two questions each from section A and B, and the entire section C is compulsory and Consist of seven questions (Candidate is to attempt any five questions).
- 2) Use of non programmable calculator is allowed in the examination centre but this will not be provided by the University/College.

Section - A

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. Packing fraction for Cubic and hexagonal closed packed structure.

Section - B

Crystal Diffraction: Bragg's Law, Experimental methods for crystal structure studies, 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.

Text Books

1. Introduction to Solid State Physics by C. Kittel (Wiley Eastern).
2. Elements of Modern Physics by S. H. Patil (TMGH, 1985).

Reference Book

1. Solid State Physics by Puri and Babbar.

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PHYB3502T: ELECTRONICS-I (ELECTRONICS AND SOLID STATE DEVICES)

Maximum Marks: External: 30
Internal: 10
Total: 40

Time Allowed: 3 Hours
Total Teaching Hours: 30
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/ internal examination, written assignment/project work etc. and attendance) carries 10 marks, and the final examination at the end of the semester carries 30 marks.

Instruction for the Paper Setter

The question paper will consist of three sections A, B and C. Each of sections A and B will have four questions from respective sections of the syllabus. Section C will have 07 short answer type questions (Candidate is to attempt any five questions), which will cover the entire syllabus uniformly. Each question of sections A and B carry 05 marks. Section C will carry 10 marks.

Instruction for the candidates

- 1) Candidates are required to attempt two questions each from section A and B, and the entire section C is compulsory and Consist of seven questions (Candidate is to attempt any five questions).
- 2) Use of non programmable calculator is allowed in the examination centre but this will not be provided by the University/College.

Section - A

Concept of current and voltage sources, p-n junction, Biasing of diode, V-A characteristics. Diode equation, Breakdown diodes: Zener breakdown and avalanche breakdown, Zener diode. Rectification: half wave, full wave rectifiers and bridge rectifiers. Qualitative analysis of Filter circuits (RC LC and π filters) Efficiency, Ripple factor. Voltage regulation. Voltage multiplier circuits.

Section - B

Junction transistor: structure and working, relation between different currents in transistors, Sign conventions. Amplifying action. Different configurations of a transistor and their comparison, CB and CE characteristics.

Structure, Characteristics, operation of FET, JFET and MOSFET, Pinch off voltage, Enhancement and Depletion mode. Comparison of JFETs and MOSFETs, Difference in field effect transistor and junction type transistor.

Photo-conductive devices: Photo-conductive cell, Photodiode, Solar cell, LED, LCD.

Text Books:

1. Basic Electronics and Linear Circuits by N. N. Bhargave, D.C. Kulshreshtha and S. C. Gupta.
2. Electronic Devices and Circuits: J. B. Gupta (Publ. KATARIA & SONS).
3. Electronic Devices and Circuits: G. K. Mithal, Khanna Publishers.
4. Fundamentals of Electronics by D. Chatopadhyay, P.C. Rakshit, B. Saha and N.N. Purkit.

Reference Book:

Basic Electronic by D.C. Tayal (Himalaya Pub.)

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PHYB3503T: NUCLEAR AND RADIATION PHYSICS

Maximum Marks: External: 30
Internal: 10
Total: 40

Time Allowed: 3 Hours
Total Teaching Hours: 30
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/ internal examination, written assignment/project work etc. and attendance) carries 10 marks, and the final examination at the end of the semester carries 30 marks.

Instruction for the Paper Setter

The question paper will consist of three sections A, B and C. Each of sections A and B will have four questions from respective sections of the syllabus. Section C will have 07 short answer type questions (Candidate is to attempt any five questions), which will cover the entire syllabus uniformly. Each question of sections A and B carry 05 marks. Section C will carry 10 marks.

Instruction for the candidates

- 1) Candidates are required to attempt two questions each from section A and B, and the entire section C is compulsory and Consist of seven questions (Candidate is to attempt any five questions).
- 2) Use of non programmable calculator is allowed in the examination centre but this will not be provided by the University/College.

Section - A

Constituents of nucleus and their intrinsic properties, Qualitative facts about size, mass, density, energy, charge. Binding energy, angular momentum, magnetic moment and electric quadruple moments of the nucleus. Wave mechanical properties of nucleus. average binding energy and its variation with mass numbers. Properties of nuclear forces. Non existence of electrons in the nucleus and neutron-proton model, Liquid drop model and semi empirical mass formula, Conditions of nuclear stability, Fermi gas model. Nuclear shell model. Experimental evidence of magic numbers and its explanation.

Section - B

Radioactivity. Modes of decay and successive radioactivity. Alpha emission. Electron emission, Positron emission. Electron capture, Gamma-ray emission, Internal conversion. Qualitative discussion of alpha, beta and gamma spectra, Geiger-Nuttal rule, Neutrino hypothesis of beta decay. Evidence of existence of neutrino, Qualitative discussion of alpha and beta decay theories, Nuclear reactions. Reaction cross section, Conservation laws. Kinematics of nuclear reaction, Q-value and its physical significance, Compound nucleus. Possible reaction with high energy particles.

Text Books:

1. An Introduction to Nuclear Physics by M.R. Bhiday and V.A. Joshi (Orient Longman).
2. Introductory Nuclear Physics by D.C. Tayal (Himalaya Pub.).

Reference Books:

1. Nuclear Physics by I. Kaplan (Addision-Wiley Pub. Co. Inc.).
2. Nuclear Physics by Burcham (Indian Ed.).
3. Concepts of Nuclear Physics by B.L. (Cohen (TMI Ed.).

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Semester- V
PHYB3504L: PRACTICALS

Maximum Marks: External: 22
Internal: 08
Total: 30

Time Allowed: 3 Hours
Pass Marks: 35%
Total Teaching Hours: 60

1. The student will be asked to perform one experiment out of the experiments mentioned in the syllabus.
2. The distribution of marks is as follows:
 - (i) One full experiment requiring the student to take some data, analyse it and draw conclusions- (candidates are expected to state their results with limits of error. (10)
 - (ii) Brief theory (04)
 - (iii) Viva-Voce (04)
 - (iv) Record (Practical File) (04)
3. There will be one session of 03 hours duration. The paper will consist of 06 experiments out of which an examinee will mark 04 experiments and one of these is to be allotted by the external examiner.
4. Number of candidates in a group for practical examination should not exceed 12.
5. In a single group no experiment is allotted to more than three students in any group.
6. The student should determine Standard Deviations and probable error in the calculations whereas needed.

LIST OF EXPERIMENTS

1. Measurement of reverse saturation current in p-n junction diode at various temperatures and to find the approximate value of energy gap.
2. To draw forward and reverse bias characteristics of a p-n junction diode and draw a load line.
3. Study of a diode as clipping element.
4. To show the variation of resistance of a thermistor with temperature
5. To measure the efficiency and ripple factors for a) Half-wave (b) full wave and (C) bridge rectifier circuits.
6. To study the reduction in the ripple in the rectified output with RC, LC and π - filters.
7. To draw the characteristics of a Zener diode
8. To study the stabilization of output voltage of a power supply with Zener diode.
9. To Plot common Emitter Characteristics of a transistor (pnp or npn)
10. To study the response of RC circuit to various input voltage (square, sine and triangular)
11. To draw output and mutual Characteristics of an FET and determine its parameters

Text and Reference Books:

1. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal.
2. B.Sc. Practical Physics, C.L. Arora.

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SEMESTER VI

PHYB3601T: CONDENSED MATTER PHYSICS-II

Maximum Marks: External: 30
Internal: 10
Total: 40

Time Allowed: 3 Hours
Total Teaching Hours: 30
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/ internal examination, written assignment/project work etc. and attendance) carries 10 marks, and the final examination at the end of the semester carries 30 marks.

Instruction for the Paper Setter

The question paper will consist of three sections A, B and C. Each of sections A and B will have four questions from respective sections of the syllabus. Section C will have 07 short answer type questions (Candidate is to attempt any five questions), which will cover the entire syllabus uniformly. Each question of sections A and B carry 05 marks. Section C will carry 10 marks.

Instruction for the candidates

- 1) Candidates are required to attempt two questions each from section A and B, and the entire section C is compulsory and Consist of seven questions (Candidate is to attempt any five questions).
- 2) Use of non programmable calculator is allowed in the examination centre but this will not be provided by the University/College.

Section - A

Lattice vibrations, Concepts of phonons, Scattering of protons by phonons. Vibration of mono-atomic, di-atomic, linear chains. Density of modes, Einstein and Debye models of specific heat, Free electron model of metals, Free electron, Fermi gas and Fermi energy.

Section - B

Band theory, Kronig-Penney Model. Metals and insulators, Conductivity and its variation with temperature in semiconductors, Fermi levels in intrinsic and extrinsic semiconductors, Qualitative discussion of band gap in semiconductors, superconductivity, Magnetic field effect in superconductors, BCS theory. Thermal properties of superconductors

Text Books:

1. Introduction to Solid State Physics by C. Kittel (Wiley Eastern)
2. Elements of Modern Physics by S. H. Patil (TMGH, 1985)

Reference Book:

1. Solid State Physics by Puri and Babbar.

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PHYB3602T: ELECTRONICS-II

Maximum Marks: External: 30
Internal: 10
Total: 40

Time Allowed: 3 Hours
Total Teaching Hours: 30
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semesters tests/ internal examination, written assignment/project work etc. and attendance) carries 10 marks, and the final examination at the end of the semester carries 30 marks.

Instruction for the Paper Setter

The question paper will consist of three sections A, B and C. Each of sections A and B will have four questions from respective sections of the syllabus. Section C will have 07 short answer type questions (Candidate is to attempt any five questions), which will cover the entire syllabus uniformly. Each question of sections A and B carry 05 marks. Section C will carry 10 marks.

Instruction for the candidates

- 1) Candidates are required to attempt two questions each from section A and B, and the entire section C is compulsory and Consist of seven questions (Candidate is to attempt any five questions).
- 2) Use of non programmable calculator is allowed in the examination centre but this will not be provided by the University/College.

SECTION-A

Thyristor, SCR, TRIAC, DIAC: Construction, Characteristics and Operation; Comparison between transistors and thyristors; Difference between SCR and TRIAC.

UJT: its construction, Equivalent circuit. Characteristics and parameters, uses.

Thermistor: Types, Construction, Characteristics, Uses, Advantages over other temperature sensing devices

IMPATT and TRAPATT devices, PIN diode: Construction, Characteristics, Applications.

SECTION-B

Gunn effect and diodes: Mechanism, Characteristic, Negative differential resistivity and Domain formation

Tunnel diode: Tunneling Phenomenon, Operation, Applications, Merits and Drawbacks

Transistor biasing: Stabilization of operating point, Fixed bias, Collector to base bias, Bias circuit with emitter resistor, Voltage divider biasing circuit.

CE amplifier: Working and analysis using h-parameters, Equivalent circuits, Determination of current gain, Power gain, Input impedance, FET amplifier: Voltage, Current and Power gain

Feed back in amplifiers: Types & advantage of negative feedback. Emitter follower as negative feed back circuit.

Text Books:

1. Basic Electronics and Linear Circuits by N. N. Bhargave, D.C. Kulshreshtha and S. C. Gupta.
2. Electronic Devices and Circuits: J. B. Gupta (Publ. KATARIA & SONS).
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4. Fundamentals of Electronics by D. Chatopadhyay, P.C. Rakshit, B. Saha and N.N. Purkit.

Reference Book:

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PHYB3603T: NUCLEAR AND PARTICLE PHYSICS

Maximum Marks: External: 30
Internal: 10
Total: 40

Time Allowed: 3 Hours
Total Teaching Hours: 30
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semesters tests/ internal examination, written assignment/project work etc. and attendance) carries 10 marks, and the final examination at the end of the semester carries 30 marks.

Instruction for the Paper Setter

The question paper will consist of three sections A, B and C. Each of sections A and B will have four questions from respective sections of the syllabus. Section C will have 07 short answer type questions (Candidate is to attempt any five questions), which will cover the entire syllabus uniformly. Each question of sections A and B carry 05 marks. Section C will carry 10 marks.

Instruction for the candidates

- 1) Candidates are required to attempt two questions each from section A and B, and the entire section C is compulsory and Consist of seven questions (Candidate is to attempt any five questions).
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SECTION-A

Energy loss due to ionization (Bethe's formula), Energy loss of electrons, Bremsstrahlung, Interactions of gamma rays with matter. Radiation loss by fast electrons, Radiation length, Electron-positron annihilation, Cyclotron, Betatron, Qualitative discussion of Synchrotron. Collider machines and linear accelerator.

SECTION-B

Ionization chamber, Proportional counter, GM counter, Scintillation counter. Solid state detectors, Elementary particles and their masses, Decay modes, Classification of these particles, types of interactions. Conservation laws and quantum numbers, Concepts of isospin. Strangeness, Parity, Charge conjugation. Antiparticles, Gell-Man method, Decay and strange particles. Particle symmetry, Introduction to quarks and qualitative discussion of the quark model.

Text Books:

1. An Introduction to Nuclear Physics by M. R. Bhiday and V. A. Joshi (Orient Longman).
2. Introductory Nuclear Physics by D.C. Tayal (Himalaya Pub.).

Reference Books:

1. Nuclear Physics by I. Kaplan (Addision-Wiley Pub. Co. Inc.)
2. Nuclear Physics by Burcham (Indian Ed.)
3. Concepts of Nuclear Physics by B.L. Cohen (TMI Ed.)
4. Particle Physics, M. P. Khanna (Prentice Hall of India)

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SEMESTER VI

PHYB3604L: PRACTICALS

Maximum Marks: External: 22
Internal: 08
Total: 30

Time Allowed: 3 Hours
Pass Marks: 35%
Total Teaching Hours: 60

1. The student will be asked to perform one experiment out of the experiments mentioned in the syllabus.
2. The distribution of marks is as follows:
 - (i) One full experiment requiring the student to take some data, analyse it and draw conclusions-(candidates are expected to state their results with limits of error. (10)
 - (ii) Brief theory (04)
 - (iii) Viva-Voce (04)
 - (iv) Record (Practical File) (04)
3. There will be one session of 03 hours duration. The paper will consist of 06 experiments out of which an examinee will mark 04 experiments and one of these is to be allotted by the external examiner.
4. Number of candidates in a group for practical examination should not exceed 12.
5. In a single group no experiment is allotted to more than three students in any group.
6. The student should have determined Standard Deviations and probable error in the calculations whereas needed.

LIST OF EXPERIMENTS

1. To measure the magnetic susceptibility of FeCl_2 solution by Quinck's method
2. To trace the B-H curves for different materials using CRO and find the magnetic parameters from these.
3. Study of a diode as clamping element
4. To Plot common base Characteristics and determine h-parameters of a given transistor
5. To study the characteristics of a thermistor and find its parameters.
6. To study the gain of an amplifier at different frequencies and to find band width and gain bandwidth product.
7. To draw the plateau of a GM counter and find its operating voltage
8. To study the statistical fluctuations of G.M. Counter to find its standard deviation.
9. To study the absorption of beta particles in aluminum using GM counter and determine the absorption coefficient of beta particles from it.
10. To study the energy resolution and calibration of a scintillation counter.
11. To plot the complete gamma ray spectrum of ^{137}Cs and mark the different peaks of the spectrum

Text and Reference Books:

1. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal.
2. B. Sc. Practical Physics, C. L. Arora.

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