B.SC. (PHYSICS) PART-III

Note :

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 practical
4. The examination time for each theory paper will be three hours
5. The examination time for practical will be four hours.
6. The use of non-programmable calculator will be allowed in the examination center but these will not be provided by the university/college.

Paper I :	Condensed Matter Physics	75 Marks	Total teaching hours 60
Paper II :	Electronics and Solid State Devices	75 Marks	Total teaching hours 60
PaperIII :	Nuclear and Particle Physics	75 Marks	Total teaching hours 60
Physics Practical :		75 Marks	Total teaching hours 120

Each theory paper will consist of five sections.

SECTION-A

There will be two questions from this section. Each question will carry 15 marks. Only one question is to be attempted.

SECTION-B

There will be two questions from this section. Each question will carry 15 marks. Only one question is to be attempted.

SECTION-C

There will be two questions from this section. Each question will carry 5 marks. Only one question is to be attempted.

SECTION-D

There will be two questions from this section. Each question will carry 15 marks. Only one question is to be attempted.

SECTION-E

There will be one question comprising of eight parts (each carrying 3 marks) of small answer type covering the syllabi of all these four sections (Sections A-D). Out of these, five parts are to be attempted.

PAPER I : CONDENSED MATTER PHYSICS

Maximum Marks : 75 Pass Marks : 35%
Total Teaching Hours : 60 Time Allowed : 3 hours

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of FIVE sections: A, B, C, D and E. Sections A, B, C and D will have two questions from the respective sections of the syllabus and will carry 15 marks each. Section E will consist of one compulsory question comprising of 8 parts (each carrying 3 marks) of small answer type covering the entire syllabus of all the sections A, B. C and D. Out of the Section E, any five parts are to be attempted.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt one question each from the sections A, B, C and D of the question paper. Out of the Section E, any five parts are to be attempted.

2. Use of non-programmable calculators is allowed in the examination but these 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 NaCI 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.

SECTION C

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 D

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.

SECTION E

Spread over the entire syllabus in Sections A-D above.

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 BOOKS

1. *Solid State Physics* by Puri and Babbar.

PAPER II : ELECTRONICS AND SOLID STATE DEVICES

Maximum Marks : 75 Pass Marks : 35%
Total Teaching Hours : 60 Time Allowed : 3 hours

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of FIVE sections : A, B, C, D and E. Sections A, B, C and D will have two questions from the respective sections of the syllabus and will carry 15 marks each. Section E will consist of one compulsory question comprising of 8 parts (each carrying 3 marks) of small answer type covering the entire syllabus of all the sections A, B, C and D. Out of the Section E, any five parts are to be attempted.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt one question each from the sections A, B, C and D of the question paper. Out of the Section E, any five parts are to be attempted.
2. Use of non-programmable calculators is allowed in the examination but these will not be provided by the university/college

SECTION A

Concepts of current and voltage sources, p-n junction, Biasing of diode, V-A characteristics. Zener diode. LED, Low Capacitance 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 transistor, Sign conventions. Amplifying action, Different configurations of a transistor and their comparison. CB and CE

characteristics, Structure of JFET and MOSFET, Transistor biasing and stabilization of operating point, Fixed bias, Collector to base bias, Bias circuit with emitter resistor, Voltage divider biasing circuit.

SECTION C

Working of CE amplifier, Amplifier analysis using h-parameters, Equivalent circuits, Determination of current gain, Power gain, Input impedance, FET amplifier and its voltage gain, Feed back in amplifiers. Different types, Voltage gain, Advantage of negative feed back, Emitter follower as negative feed back circuit.

SECTION D

Barkhausen criterion of sustained oscillations, LC oscillator (tuned collector, tuned grid, Hartley qualitative), RC oscillators. phase shift and Wein bridge, Modulation and detection. AM and FM, Power in AM and generation of AM, AM detector, Radio transmitter, Radio wave propagation. Ionosphere, Radio receiver. TV receiver.

SECTION E

Spread over the entire syllabus in Sections A-D above.

TEXT BOOKS

1. *Basic Electronics and linear Circuits* by N.N. Bhargave, D.C. Kulshreshtha and S.C.Gupta
2. *Foundations of Electronics* by D. Chatopadhyay, P.c. Rakshit, B. Saha and N.N. Purkit

REFERENCE BOOKS

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

PAPER III: NUCLEAR AND PARTICLE PHYSICS

Maximum Marks : 75 Pass Marks : 35%
Total Teaching Hours : 60 Time Allowed : 3 hours

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of FIVE sections: A,B,C,D and E. Sections A, B, C and D will have two questions from the respective sections of the syllabus and will carry 15 marks each. Section E will consist of one compulsory question comprising of 8 parts (each carrying 3 marks) of small answer type covering the entire syllabus of all the sections A, B. C and D. Out of the Section E, any five parts are to be attempted.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt one question each from the sections A, B, C and D of the question paper. Out of the Section E, any five parts are to be attempted.
2. Use of non-programmable calculators is allowed in the examination but these 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 and saturation, Non existence of electrons in the nucleus and neutron-proton model, Assumptions of liquid drop model. 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.

SECTION C

Energy loss due to ionization (Bethe Block formula), Energy loss of electrons, Bremsstrahlung, Multiple Coulomb scattering, Gamma-ray through matter. Pair production, Radiation loss by fast electrons. Radiation length, Electron-positron annihilation, Cyclotron. Betatron, Qualitative discussion of Synchrotron, Collider machines and linear accelerator.

SECTION D

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.

SECTION E

Spread over the entire syllabus in Sections A-D above.

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 Bucham (Indian Ed.)
3. Nuclear Physics by S.S.M. Wong
4. Concepts of Nuclear Physics by B.L. (Cohen (TMI Ed.)
5. Particle Physics, M.P. Khanna, (Prentice Hall of India)

PRACTICAL

Total Teaching Hours : 120 Hrs. Pass Marks : 35%
Maximum Marks : 75 Time Allowed : 4 Hours

Guidelines for Physics Practical Examination

1. The distribution of marks is as follows:
   (i) One full experiment requiring the students to take some data, analyze it and draw conclusions. (Candidates are expected to state their results with limits of error 30 marks
   (ii) Brief theory 07 marks
   (iii) One exercise based on experiment or computer programming
   (to be allotted by the external examiner at the time of examination) 15 marks
   (iv) Viva-voce 15 marks
   (v) Record (Practical file) 08 marks
2. There will be one session of 4 hrs duration. The paper will have two sections. Section A will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.
3. Section B will consist of 6 exercises out of which at least two should be exercises based on computers 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. Out of 6 exercises the examinee will mark 4 exercises, and one of them is to be allotted by the external examiner.
4. 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.
5. Number of candidates in a group for practical examination should not exceed 12.
6. In a single group, no experiment be allotted to more than three examinees.

List of Experiments

I. Condensed Matter Physics:

Activities :

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
v. To trace the B-H curves for different materials using CRO and find the magnetic parameters from these.

II. Electronics and Solid State Devices :

i. To study the response of RC circuit to various input voltages (square, sine and triangular).
ii. To measure the efficiency and ripple factors for (a) Half-wave (b) full wave and (c) bridge rectifier circuits
iii. To study the reduction in the ripples in the rectified output with RC. LC and π filters.
iv. To draw the characteristics of a Zener diode.
v. To study the stabilization of output voltage of a power supply with Zener diode.
vi. To plot Common Emitter Characteristics of a transistor (pnp or npn)
vii. To plot Common Base Characteristics and determine h-parameters of a given transistor.
viii. To draw output and mutual characteristics of an FET and determine its parameters.
ix. To study the gain of an amplifier at different frequencies and to find band width and gain-bandwidth product.
x. To set up an oscillator and study its output on CRO for different frequencies.
xi. To study the characteristics of a thermistor and find its parameters.

III. Nuclear and Particle Physics :

i. To draw the plateau of a GM counter and find its dead time.
ii. To study the statistical fluctuations and end point energy of beta particles using GM counter.
iii. To study the absorption of beta particles in aluminium using GM counter and determine the absorption coefficient of beta particles from it.
iv. To study the energy resolution and calibration of a scintillation counter.

Exercises: Based on he above given experiments (i-xi) and computer based exercises (xii-xx)

i. To trace the output waveform of full wave and half wave rectifiers.
ii. To trace the rectifier output with RC, LC, and π filters.
iii. To show the constant output voltage of Zener diode.
iv. To study the bandwidth of a transistor amplifier.
v. To show the variation of resistance of a thermistor with temperature.
vi. To find different frequencies using CRO
vii. To plot two different gamma ray peaks using scintillation detector.
viii. Determine the plateau of a GM counter.
ix. To study the absorption of beta particles in different materials like Pb. Fe. AI. etc. using GM counter.
x. To locate the peak position with gain of an amplifier of gamma ray spectrometer.
xi. To plot the complete gamma ray spectrum of ^{137}CS and mark the different peaks of the spectrum.
xii. To integrate a given function by Trapezoidal rule.
xiii. To integrate a given function by Simpson's rule.
xiv. Find real root of a given equation by Bisection method.
xv. Find real root of a given equation by Newton-Raphson's method.
xvi. Solve a first order differential equation by RK2 method
xvii. Find first four perfect numbers.
xviii. Find transpose of a given matrix and add and subtract given two matrices.
xix. Multiply a given matrix by a scalar constant and multiply given two matrices.
xx. Quadratic interpolation using Newton's forward difference formula of degree two.

TEXT AND REFERENCE BOOKS:

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

3. *Computer Programming-I* by R.C. Verma, V.K. Mittal and S.C. Gupta. Vishal Publishers. Jalandhar, 2003
4. *FORTRAN 77 and Numerical Methods,* C. Xavier (New Age Int. Pvt. Ltd. N. Delhi) 1996.
5. *Computer Simulation in Physics* by R.C. Verma, Anamaya Pub., N.Delhi;. 2004

B.SC. PART-III PHYSICS (HONOURS)

Two paper of one credit each

(3 periods per week per paper)

PAPER I : QUANTUM MECHANICS

Max. Marks : 100 Total Teaching Periods : 75
Pass Marks : 35% in the subject Time Allowed : 3 hours

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five sections: A, B, C, D & E. Section A, B, C & D will have two questions from the respective sections of the syllabus and will carry 15 marks each. Section E will consist of 10 short answer type questions which will cover the entire syllabus uniformly and will carry 40 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt one question each from the sections A, B, C and D of the question paper and the entire section E.

SECTION-A

Inadequacy of classical concepts, black body radiation, the photoelectric effect, the Compton effect, de Broglie hypothesis, the motion of a free wave packet: 'classical approximation and the uncertainity principle. Uncertainity introduced in the process of measurement.

SECTION-B

Approximate classical motion in slowly varying fields. Diffraction phenemena : Interpretation of the wave particle dualism, complementarity, the formulation of quantum mechanics. The Schrodinger equation for a free particle in one dimension, the operator correspondence and the Schrodinger equation for a particle subject to forces, physical interpretation and conditions on wave function, Normalisation and probability inter relation, conservation of probability, Expectation values, Ehrenfest theorem, stationary states.

SECTION-C

The time independent Schrodinger equation, a particle in a square well potential, Square potential barrier, Hermite Polynomial, the one dimensional Harmonic oscillator, Properties of its stationary states. Angular momentum operator, The eigen value for 1_z, spherical harmonics, Physical interpretation.

SECTION-D

The rigid rotator. Three dimensional square well potential. The Hydrogen atom, Energy levels. Stationary state wave function, Discussion of bound States. Perturbation theory for discrete levels, The non-degenerate and degenerate case, Stark effect of two electron atoms.

BOOK

A Text Book of Quantum Mechanics, Mathews and Venkatesan (McGraW-Hill).

PAPER II : COMPUTER PROGRAMMING IN BASIC

Max. Marks : 100 Total Teaching Periods : 75
Pass Marks : 35% in the subject Time Allowed : 3 hours

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of five sections: A, B, C, D & E. Section A, B, C & D will have two questions from the respective sections of the syllabus and will carry 15 marks each. Section E will consist of 10 short answer type questions, which will cover the entire syllabus uniformly and will carry 40 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt one question each from the sections A, B, C and D of the question paper and the entire section E.

SECTION-A

Introductory concepts relating to computers (Ch. I, including all problems). Introduction to BASIC including flow chart (Ch. 2 All solved examples and problems 2, 1.2.50 problems 2.61.2.63) and basic steps for running of a programme (Ch. 3)

SECTION-B

Branching and looping (Ch. 4, all solved examples and problem 4.14, 45). Additional features of BASIC such as Library functions, subscripted variables, I/O statements (Ch. 5 including all problems: solved and unsolved).

SECTION-C

Functions and subroutines in BASIC, Change statement, Randomize statement, graphical output (Ch. 6, all solved examples and problems 6.16,50) Scalar and Matrix operations in BASIC (Ch. 7, 11) problems and examples).

SECTION-D

Data files in BASIC (Ch. 8, all problems) Micro-computer basics (Ch. 9, problems 9.41.9.70 unsolved and all solved examples).

BOOK

Programming with BASIC (IInd Edition) Schaum Series (McGraw-Hill by B.S. Gottfred).