SCHEME

B.Sc. (Physics) Part-II (IIIrd and IVth Semester)

SESSION 2021-22, 2022-23, 2023-24

Code	Title of Paper	No of Lectures	Max Marks			Examination Time (Hours)
SEMESTER -I			Total	Ext.	Int.	
Paper- I	Statistical Physics and Thermodynamics-I	40	40	30	10	03
Paper- II	Optics	40	40	30	10	03
Paper - III	Quantum Mechanics-I	40	40	30	10	03
Paper - IV	Physics Practical Lab	80	30	22	08	03
SEMESTER -II						
Paper- I	Statistical Physics and Thermodynamics-II	40	40	30	10	03
Paper - II	Lasers	40	40	30	10	03
Paper - III	Quantum Mechanics-II	40	40	30	10	03
Paper - IV	Physics Practical Lab	80	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 nonprogrammable 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 nonprogrammable 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 questions are to be attempted.

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SEMESTER - III

PAPER-I: STATISTICAL PHYSICS AND THERMODYNAMICS-I

Maximum Marks: External 30
Internal 10
Total 40

Time Allowed: 3 Hours
Total Teaching hours: 40
Pass Marks: 35 %

Out of 40 Marks, internal assessment (based on two mid-semester tests/internal examinations, 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 carries 05 marks. Section C will carry 10 marks and each question is of 2 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 has to attempt any five questions).

2) Use of nonprogrammable calculator is allowed in the examination centre but this will not be provided by the University/College.

SECTION - A

Basic ideas of statistical physics, Scope of statistical physics, Basic ideas about probability, distribution of four distinguishable particles in two compartment of equal size. Concept of macro states, 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.

SECTION - B

Phase space and its division into elementary cells, Three kinds of statistics. The basic approach in the three statistics, Maxwell Boltzman (MB) statistics applied to an ideal gas in equilibrium. Experimental verification of Maxwell Boltzman law of distribution of molecular speeds, Need for quantum statistics-Bose-Einstein (B.E.) statistics, Derivation of Planck's law of radiation, Deduction of Wien's displacement law and Stefan's law from Planck's law, Fermi-Dirac (F.D.) statistics, Comparison of M.B., B.E. and F.D. statistics.

Text Books:

1. Statistical Physics and Thermodynamics, V.S. Bhatia (Sohan Lal Nagin Chand, Jalandhar)
2. Statistical Physics and Thermodynamics, A.K. Sikri (Pardeep Publication, Jalandhar)
3. A Treatise on Heat, M.N. Saha & B.N. Srivastava, (The Indian Press Pvt. Ltd., Allahabad) 1965.

Reference Books

1. Statistical Mechanics: An Introductory Text, Bhattacharjee, J.K. (Allied Pub., Delhi) 2000.
2. Statistical Physics, Bhattacharjee, J.K. (Allied Pub., Delhi) 2000.
3. Statistical Mechanics, B.B. Laud (Macmillan India Ltd), 1981.

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PAPER-II: OPTICS

Maximum Marks:	External	30	Time Allowed: 3 Hours
	Internal	10	Total Teaching hours: 40
	Total	40	Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/internal examinations, 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 carries 05 marks. Section C will carry 10 marks and each question is of 2 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 has to attempt any five questions).

2) Use of nonprogrammable calculator is allowed in the examination centre but this will not be provided by the University/College.

SECTION - A

Interference: Concept of coherence, Spatial and temporal coherence. Coherence time, Coherence length, Area of coherence, Conditions for observing interference fringes, Interference by wave front division and amplitude division, Michelson's interferometer—working, Principle and nature of fringes, Interference in thin films, Role of interference in anti-reflection and high reflection dielectric coatings. Multiple beam interference, Fabry-Perot interferometer, Nature of fringes, Newton Rings.

SECTION - B

Diffraction: Huygens-Fresnel theory, half-period zones, Zone plates, Distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at rectangular and circular apertures, Effects of diffraction in optical imaging, resolving power of telescope. The diffraction grating, its use as a spectroscopic element and its resolving power.

Polarization: Concept and analytical treatment of un-polarized, plane polarized and elliptically polarized light. Double refraction, Nicol prism, Sheet polarizer, Retardation plates, Production and analysis of polarized light (quarter and half wave plates).

Text Books:

1. Fundamentals of Optics, F.A. Jenkins and Harvery E. White (McGraw Hill) 4th edition, 2001.
2. Optics, Ajoy Ghatak (McMillan India) 2nd edition, 7th reprint 1997.
3. Introduction to Atomic Spectra, H.E. White (McGraw Hill Book Co.)

Reference Book:

1. Optics, Born and Wolf (Pergamom Press), 3rd edition, 1965.

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PAPER-III: QUANTUM MECHANICS-I

Maximum Marks: External 30
Internal 10
Total 40

Time Allowed: 3 Hours
Total Teaching hours: 40
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/internal examinations, 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 carries 05 marks. Section C will carry 10 marks and each question is of 2 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 has to attempt any five questions).

2) Use of nonprogrammable calculator is allowed in the examination centre but this will not be provided by the University/College.

SECTION - A

Formalism of Wave Mechanics: Brief introduction to need and development of quantum mechanics, Wave-particle duality, de-Broglie hypothesis, Complimentarity and uncertainty principle, Gaussian wave-packet, Schrodinger equation for a free particle, operator correspondence and equation for a particle subject to forces. Normalization and probability
Interpretation of wave function, Super position principle, Expectation value, probability current and conservation of probability, Admissibility conditions on the wave function. Ehrenfest theorem, Fundamental postulates of wave mechanics, Eigen functions and eigen values. Operator formalism, Orthogonal systems, Expansion in eigen functions, Hermitian operators. Simultaneous eigen functions. Equation of motion.

SECTION - B

Problems in one and three dimensions: Time dependent Schrodinger equation. Application to stationary states for one dimension, Potential step, Potential barrier, Rectangular potential well, Degeneracy, Orthogonality, Linear harmonic oscillator, Schrodinger equation for spherically symmetric potential, Spherical harmonics. Hydrogen atom energy levels and eigen functions. Degeneracy, Angular momentum.

Text Books:

1. Quantum Mechanics by V.K. Thankappan.
2. A Text Book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, (Tata McGraw Hill Pub. Co. Delhi), 2002.
3. Quantum Mechanics, J .L. Powell and B. Crasemann (Narosa Pub. House, N. Delhi) 1997.

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PAPER- IV: PHYSICS PRACTICAL LAB

General Guidelines for Physics Practical Examination

Maximum Marks: External 22
Internal 08
Total 30

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 08 experiments out of which an examinee will mark 06 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 Adiabatic expansion of a gas
2 Thermal expansion of crystal using interference fringes
3 Probability distribution using coloured dice coins.
4 To determine the refractive index of liquid using spectrometer
5 To determine the Cauchy's constants
6 To study the refractive index of doubly refracting prism
7 To determine the wave length of a given light using bi-prism
8 To determine the resolving power of a telescope
9 To determine the principal points of a lens system
10 Study the photoelectric effect and determine the value of Planck's constant
11 To study the gas discharge spectrum of hydrogen
12 To determine the angle of wedge using interference method

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-IV

PAPER-I: STATISTICAL PHYSICS AND THERMODYNAMICS-II

Maximum Marks : External 30
Internal 10
Total 40

Time Allowed: 3 Hours
Total Teaching hours: 40
Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/internal examinations, 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 carries 05 marks. Section C will carry 10 marks and each question is of 2 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 has to attempt any five questions).

2) Use of nonprogrammable calculator is allowed in the examination centre but this will not be provided by the University/College.

SECTION-A

Statistical definition of entropy, Change of entropy of a system, Additive nature of entropy, Law of increase of entropy, Reversible and irreversible process and their examples. Work done in a reversible process. Examples of increase of entorpy in natural processes, Entropy and disorder, Brief review of terms and laws of thermodynamics, Carnot's cycle, Entropy changes in Carnot 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 an ideal gas from simple statistical consideration, Heat death of the universe.

SECTION-B

Derivation of Maxwell's thermo dynamical relations, Cooling produced by adiabatic streching, Adiabatic compression, Change of internal energy with volume, specific heat at constant pressure and constant volume, Expression for Cp -Cv , Change of state and Clayperon equation, Thermo dynamical treatment of Joule-Thomson effect, Use of Joule-Thomson effect, liquefiction of helium, Production of very low temperature by adiabatic demagnetization.

Text Books:

1. Statistical Physics and Thermodynamics, V.S. Bhatia (Sohan Lal Nagin Chand, Jalandhar)
2. Statistical Physics and Thermodynamics, A.K. Sikri (Pardeep Publication, Jalandhar)
3. A Treatise on Heat, M.N. Saha & B.N. Srivastava, (The Indian Press Pvt. Ltd., Allahabad) 1965.

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PAPER-II: LASERS

Maximum Marks:	External	30	Time Allowed: 3 Hours
	Internal	10	Total Teaching hours: 40
	Total	40	Pass Marks: 35%

Out of 40 Marks, internal assessment (based on two mid-semester tests/internal examinations, 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 carries 05 marks. Section C will carry 10 marks and each question is of 2 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 has to attempt any five questions).

2) Use of nonprogrammable calculator is allowed in the examination centre but this will not be provided by the University/College.

SECTION-A

Laser Fundamentals : Derivation of Einstein's relations. Concept of stimulated emission and population inversion. Broadening of spectral lines, natural, collision and Doppler broadening. Line width, Line profile, Absorption and amplification of a parallel beam of light passing through a medium. Threshold condition, Introduction of three level and four level laser schemes, elementary theory of optical cavity, Longitudinal and transverse modes.

SECTION-B

Laser Systems : types of lasers, Ruby and Nd: YAG lasers, He-Ne and CO_2 lasers-construction, mode of creating population inversion and output characterstics. Semiconductor lasers, Dye lasers, Q-switching, Mode locking, Applications of lasers–a general outline. Basics of holography.

Text Books:

1. Laser Fundamentals, W.T. Silfvast (Foundation Books), New Delhi,1996.
2. Lasers and Non-linear Optics, B.B. Laud (New Age Pub.), 2002.

Reference Book:

1. Lasers, Svelto (Plenum Press), 3rd Ed., New York.

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PAPER-III: QUANTUM MECHANICS-II

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Total 40

Time Allowed: 3 Hours
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Pass Marks: 35%

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Instruction for the Paper Setter

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SECTION-A

One Electron Atomic Spectra: Excitation of atom with radiation. Transition probability, Spontaneous transition, Selection rules and life time, Spectrum of hydrogen atom. Frank Hertz Experiment, Line structure, Normal Zeeman effect, Electron spin, 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).

SECTION-B

Many Electron System Spectra: Exchange symmetry of wave functions, exclusion principle, Shells, Sub shells in atoms, atomic spectra (Helium), L.S. coupling, Selection rules, Regularities in atomic spectra, Interaction energy, X-ray spectra, Mosley law, Absorption spectra, Auger effect. Molecular bonding, Molecular spectra, Selection rules, Symmetric structures, Rotational, vibrational electronic level and spectra of molecules, Raman spectra.

Text Books:

1. Concepts of Modern Physics, Arthur Beiser (McGraw Hill Pub. Co., Delhi, 9th ed.), 1995.
2. Elements of Modern Physics, S.H. Patil (McGraw Hill), 1998.

Reference Books:

1. Quantum Mechanics, E. Merzbacher (John Wiley, 2nd ed.)
2. Fundamental of Molecular Spectroscopy, C.N. Banwell (Tata McGraw Hill Pub. Co., Delhi), 2001.
3. Atomic Spectra, H.G. Kuhn (Longmans), 2nd ed., 1969.
4. Introduction to Quantum Mechanics, L. Pauling and E.B. Wilson(Tata McGraw Hill Pub. Co., Delhi), 2002.
5. Quantum Mechanics, W. Greiner (Springer Verlag), 1994.

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PAPER-IV: PHYSICS PRACTICAL LAB

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   (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 08 experiments out of which an examinee will mark 06 experiments and one of these is to be alloted 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 be 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. Thermal conduction in poor conductor (variation with geometry) by Lee's method
2. Thermo e.m.f. calibration comparison
3. Total radiation law, temperature dependence of radiation
4. Study of rotation of plane of polarization with a polarimeter.
5. Set up Newton's rings to determine wave length of sodium light
6. To determine the wave length and dispersive power using plane diffraction grating (Use Hg source)
7. To determine the resolving power of a grating
8. To measure an inaccessible height using sextant
9. To determine the divergence and wave length of a given laser source.
10. To study the absorption spectra of iodine vapours
11. To determine the ionization potential of mercury
12. Study of variation of light intensity using photovoltaic cell/inverse square law

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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