FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. (Hons.) PHYSICS

PART-II

(Semester: III, IV)

Session: 2018-2019

MATA GUJRI COLLEGE

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SCHEME

B.Sc. (Hons.) PHYSICS PART-II (III & IV SEMESTER)
SESSION:- 2018-19

B.SC. (HONS) PHYSICS- SEMESTER III						
COURSE CODE	**COURSE OPTED**	**COURSE NAME**	**CREDITS**	**Maximum Marks (Pass Marks 40%)**	**External Examination**	**Internal Assess-ment**
BPH301	Core Course-V	Lasers	4	100	75	25
BPH 301P	Core Course-V Practical/Tutorial	Physics Lab	2	50	50	--
BPH 302	Core Course-VI	Solid State Physics-I	4	100	75	25
BPH302P	Core Course-VI Practical/Tutorial	Physics Lab	2	50	50	--
BPH 303	Core Course-VII	Statistical Physics and Thermodynamics	4	100	75	25
BPH 303P	Core Course-VII Practical/Tutorial	Physics Lab	2	50	50	--
BPH304	Skill Enhancement Course-I	SEC-I	2	50	50	--
BPH305A/B/C	*Generic Elective-III	*GE-III	4/5	100	75	25
BPH305PA/B/C	Generic Elective-III Practical/Tutorial	GE-III LAB	2/1	50	35	15

Total Marks: Semester III=650 marks, Total Credits: 26

*Generic Elective (GE-3): Subject options for Generic Elective in continuation with semester I

1. [Code: BPH305A] **Mathematics** [DIFFERENTIAL EQUATIONS]

2. [Code: BPH305B] **Chemistry** [SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY]

3. [Code: BPH305C] **Computer** [COMP-3: DATA STRUCTURE]

SCHEME

B.Sc. (Hons.) PHYSICS PART-II (SEMESTER IV)

SESSION:- 2018-19

(SEMESTER IV)

COURSE CODE	COURSE OPTED	COURSE NAME	CREDITS	Maximum Marks (Pass Marks 40%)	External Examination	Internal Assessment
BPH 401	Core Course-VIII	Solid State Physics-II	4	100	75	25
BPH 401P	Core Course-VIII Practical/Tutorial	Physics Lab	2	50	50	--
BPH 402	Core Course-IX	Quantum Mechanics	4	100	75	25
BPH 404P	Core Course-IX Practical/Tutorial	Physics Lab	2	50	50	--
BPH 403	Core Course-X	Spectroscopy	4	100	75	25
BPH 403P	Core Course-X Practical/Tutorial	Physics Lab	2	50	50	--
BPH404	Skill Enhancement Course-II	SEC-II	2	50	50	--
BPH405 A/B/C	*Generic Elective-IV	*GE-IV	4/5	100	75	25
BPH405P A/B/C	*Generic Elective-IV Practical/Tutorial	GE-IV LAB	2/1	50	35	15

Total Marks: Semester IV=650 marks, Total Credits: 26

*Generic Elective (GE-4): Subject options for Generic Elective in continuation with semester I

1. [Code: BPH405 A] **Mathematics** [APPLIED STATISTICS]
2. [Code: BPH405 B] **Chemistry** [TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS]
3. [Code: BPH405 C] **Computer** [COMP-4: DATABASE MANAGEMENT SYSTEMS]

Session: 2018-2019

B.Sc. (Hons.) Physics-Semester III

CORE COURSE-V

LASERS

(CODE: BPH 301)

Maximum Marks: 100 **Time: 3 Hrs**

External Examination: 75 **Pass marks: 40%**

Internal Assessment: 25

Instruction for the Paper Setter: The question paper will consist of three sections A, B, and C. Sections A and B will have four questions from respective sections of the syllabus carrying 12 marks each. Section C will have 9 short answer type questions, which will carry 27 marks and cover the entire syllabus uniformly.

Instruction for the candidates: The candidates are required to attempt two questions each from sections A and B of the question paper and entire section C.

SECTION A

Introductory Concepts of Lasers: Spontaneous and Stimulated Emission, Concept of Population Inversion, The Laser Idea, Properties of Laser Light.

Interaction of Radiation With Matter: Einstein's Theory, Rates of Absorption, Spontaneous and Stimulated Emission. Allowed and Forbidden Transitions, Broadening of Spectral Lines, Natural, Collision and Doppler Broadening.

Laser rate equation: Pumping Processes, Three Levels and Four Level Laser, Optimum and Output Coupling, Laser Spiking, Q Switching, Mode Locking.

SECTION-B

Resonators (Concept and Theory): Passive Optical Resonators: Photon Lifetime and Cavity Q, Plane Parallel Resonator, Confocal Resonator.

Types of Lasers: Lasers Construction, Ruby Laser, Nd: YAG Laser, He-Ne Laser, CO_2 Laser, Excimer Laser, Dye Lasers, Semiconductor Lasers.

Application of lasers: Holography, Laser Printing, Applications in Industry: Laser Drilling, Laser Welding and Cutting, Applications of Lasers for Data Storage, Medical Applications of Lasers.

Reference Books:

1. Lasers Fundamentals, W.T Silfvast (Foundation Books).
2. Principles of Lasers, O. Svelto (Plenum Press).
3. Lasers and its applications: A.K. Ghatak and K. Thyagrajan.
4. Lasers and Nonlinear Optics: B.B. Laud (2^{nd} Ed.), Wiley Eastern.

Session: 2018-2019

B.Sc. (Hons.) Physics-Semester III

CORE COURSE-VI

SOLID STATE PHYSICS-I

(CODE: BPH 302)

Maximum Marks: 100
External Examination: 75 **Pass marks: 40%**
Internal Assessment: 25

Instruction for the Paper Setter: The question paper will consist of three sections A, B, and C. Sections A and B will have four questions from respective sections of the syllabus carrying 12 marks each. Section C will have 9 short answer type questions, which will carry 27 marks and cover the entire syllabus uniformly.
Instruction for the candidates: The candidates are required to attempt two questions each from sections A and B of the question paper and entire section C.

SECTION-A

Crystal Structure: Crystal Structure, Symmetry Operations for Two Dimensional Crystal, Two Dimensional Bravais Lattice, Three Dimensional Bravais Lattice, Basic Primitive Cell, Crystal Planes and Miller Indices, Cubic Unit Cell System, Diamond and NaCl Structure, Packing Fraction for Cubic and Hexagonal Closed Packed Structure.

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-B

Lattice Vibrations: Lattice Vibrations of Mono-atomic and Diatomic Linear Lattices, Concept of Phonons, Momentum of Phonons and Conservation of Wave Vector, Inelastic Scattering of Photon by Phonons.

Specific Heat of Solids: Classical Theory of Specific Heat due to Vibrating Lattice, Einstein Theory of Heat Capacity and Its Drawbacks, Debye Model of Specific Heat and Its Limitations, Vibrational Modes of a Continuous Medium, Debye Approximation.

TEXT BOOKS

1. Introduction to Solid State Physics by C. Kittle (Wiley Publishers).

2. Elements of Modern Physics by S.H Patil.

3. Elements of Solid State Physics by J.P. Srivastava (Prentice Hall India Pvt. Ltd.).

4. Solid State Physics by Gupta, Kumar, Sharma (Pragati Parkashan, Meerut).

REFERENCE BOOKS

1. Solid State Physics by Puri and Babbar (S. Chand Publications).
2. Solid State Physics by S.O. Pillai (New Age International Pvt. Ltd. Pub.)

Session: 2018-2019

B.Sc. (Hons.) Physics-Semester III

CORE COURSE-VII

STTISTICAL PHYSICS AND THERMODYNAMICS

(CODE: BPH 303)

Maximum Marks: 100 **Time: 3 Hrs**

External Examination: 75 **Pass marks: 40%**

Internal Assessment: 25

Instruction for the Paper Setter: The question paper will consist of three sections A, B, and C. Sections A and B will have four questions from respective sections of the syllabus carrying 12 marks each. Section C will have 9 short answer type questions, which will carry 27 marks and cover the entire syllabus uniformly.

Instruction for the candidates: The candidates are required to attempt two questions each from sections A and B of the question paper and entire section C.

SECTION-A

Statistical Physics: Basic Ideas of Statistical Physics, Basic Ideas about Probability, Distribution of Four Distinguishable Particles in Two Compartments of Equal Size, Concept of Macrostate and Microstates, Thermodynamical Probability, Effect of Constraints on the System, Static and Dynamic System.

Distribution of Particles: Distribution of *n* Particles in Two Compartments, Deviation From the State of Maximum Probability, Distribution of Distinguishable *n* Particles in *k* Compartments of Unequal Sizes.

Classical Statistics: Phase Space and Division into Elementary Cells, Three Kinds of Statistics, Basic Approach in the Three statistics, Maxwell Boltzmann (MB) Statistics Applied to an Ideal Gas in Equilibrium.

Quantum statistics: Need of Quantum Statistics, Bose Einstein (BE) Statistics, Fermi Dirac (FD) Statistics, Comparison of MB, BE, and FD Statistics.

SECTION-B

Entropy: Statistical Definition of Entropy, Change of Entropy of a System, Additive Nature of Entropy, Law of Increase of Entropy, Reversible and Irreversible Process and With Examples, Work Done in a Reversible Process, Examples of Increase of Entropy in Natural Processes, Entropy and Disorder.

Laws of thermodynamics and Carnot cycle: 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.

TEXT BOOKS

1. Statistical Physics and Thermodynamics, V.S Bhatia (Sohan Lal nagin Chand, Jalandhar)

2. Statistical Physics and Thermodynamics, A.K Sikri (Pardeep Pub.)

REFERENCE BOOKS

1. Statistical Mechanics: An Introductory Text, Bhattacharjee, J.K (Allied Pub. Delhi)

2. Statistical Mechanics, B.B Laud (Macmillan India Ltd.)

Session: 2018-2019

PHYSICS WORKSHOP SKILL

(CODE: BPH 304)

Total Credits: 02 **Total Lectures: 30**

Maximum Marks: 50 **Pass marks: 40%**

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode

SECTION-A

Introduction: Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

SECTION-B

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN:0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN:0861674480]

Session: 2018-2019

B.Sc. (Hons.) Physics-Semester IV

CORE COURSE-VIII

SOLID STATE PHYSICS-II
(CODE: BPH 401)

Maximum Marks: 100 **Time: 3 Hrs**

External Examination: 75 **Pass marks: 40%**

Internal Assessment: 25

Instruction for the Paper Setter: The question paper will consist of three sections A, B, and C. Sections A and B will have four questions from respective sections of the syllabus carrying 12 marks each. Section C will have 9 short answer type questions, which will carry 27 marks and cover the entire syllabus uniformly.

Instruction for the candidates: The candidates are required to attempt two questions each from sections A and B of the question paper and entire section C.

SECTION-A

Free Electron Theory of Metals: Free Electron Gas Model (Drude model), Free Electron Gas in One and Three Dimensions, its Fermi Energy, Total Energy and Density of States, Fermi Dirac Statistics and Electronic Distribution in Solids.

Band Theory of Solids: Bloch Function, Bloch Theorem, Kronig Penney Model, Number of Possible Wave Functions in a Band, Velocity and Effective Mass of Electron, Distinction between Metals, Insulators and Intrinsic Semiconductor on the Basis of Band Theory.

SECTION-B

Semiconductors: Types of Semiconductors, Conductivity and Its Variation with Temperature in Semiconductors, Carrier Concentration and Fermi Level of Intrinsic and Extrinsic Semiconductor, Fermi Level in Intrinsic and Extrinsic Semiconductors, Qualitative Discussion of Band Gap in Semiconductors.

Magnetic Properties: Clausius Mossotti Relation, Types of Polarizibility: Electronic and Ionic Polarizibility, Diamagnetism, Paramagnetism and Ferromagnetism.

Superconductivity: Effect of Magnetic Field on Superconductors, Meissner Effect, Types of Superconductor (Type I and Type II) and Its Application, Thermodynamic Properties of Superconductors, BCS Theory.

TEXT BOOKS

1. Introduction to Solid State Physics by C. Kittle (Wiley Publishers)
2. Elements of Modern Physics by S.H Patil.
3. Elements of Solid State Physics by J.P. Srivastava (Prentice Hall India Pvt. Ltd.).
4. Solid State Physics by Gupta, Kumar, Sharma (Pragati Parkashan, Meerut).

REFERENCE BOOKS

3. Solid State Physics by Puri and Babbar (S. Chand Publications).
4. Solid State Physics by S.O. Pillai (New Age International Pvt. Ltd. Pub.)

Session: 2018-2019

B.Sc. (Hons.) Physics-Semester III
CORE COURSE-IX
QUANTUM MECHANICS
(CODE: BPH 402)

Maximum Marks: 100 **Time: 3 Hrs**

External Examination: 75 **Pass marks: 40%**

Instruction for the Paper Setter: The question paper will consist of three sections A, B, and C. Sections A and B will have four questions from respective sections of the syllabus carrying 12 marks each. Section C will have 9 short answer type questions, which will carry 27 marks and cover the entire syllabus uniformly.

Instruction for the candidates: The candidates are required to attempt two questions each from sections A and B of the question paper and entire section C.

SECTION-A

Origin of Quantum Mechanics: Brief Introduction to Need and Development of Quantum Mechanics, Wave Particle Duality, de-Broglie Hypothesis, Uncertainty Principle and Its Application, Postulates of Quantum Mechanics, Operator Correspondence and Equation for a Particle Subject to Force.

Wave Mechanics: Gaussian Wave Packet, Schrodinger Equation for a Free Particle, Physical Interpretation of Wave Function, Superposition Principle, Expectation Value, probability current and Conservation of Probability, Admissibility Conditions on the Wave Function, Normalization and Orthogonality Property, Ehrenfest Theorem.

SECTION-B

Operators, Eigenvalues and Eigenfunction: Operators, Eigenvalues and Eigenfunction, Linear Operators, Hamiltonian Operator, Linear Momentum and Angular Momentum Operators, Product of Two Operators, Commuting and Noncommuting Operators, Simultaneous Eigenfunctions, Orthogonal Functions, Hermitian Operators, their Eigenvalues, Hermitian Adjoint Operators, Expectation Value of Position and Momentum Operator.

Problems in One Dimension: Time Dependent Schrodinger Equation, Application to Stationary States for One Dimension, Potential Step, Potential Barrier, Rectangular Potential Well, Degeneracy, Orthogonality, Linear Harmonic Oscillator.

Problem in Three Dimensions: Schrodinger Equation for Spherically Symmetric Potential, Spherical Harmonics, Hydrogen Atom Energy Levels and Eigen Functions, Degeneracy, Angular Momentum.

TEXT BOOKS

1. Concepts of Modern Physics, Arthur Beiser (McGraw Hill Pub.)
2. Elements of Modern Physics, S.H Patil (McGraw Hill)
3. Quantum Mechanics, P.M Mathews and K. Venkatesan (Tata McGraw Hill Pub.)
4. Quantum Mechanics, E. Merzbacher (John Wiley)

Session: 2018-2019

B.Sc. (Hons.) Physics-Semester III

CORE COURSE-X

SPECTROSCOPY

(CODE: BPH 403)

Maximum Marks: 100 **Time: 3 Hrs**

External Examination: 75 **Pass marks: 40%**

Instruction for the Paper Setter: The question paper will consist of three sections A, B, and C. Sections A and B will have four questions from respective sections of the syllabus carrying 12 marks each. Section C will have 9 short answer type questions, which will carry 27 marks and cover the entire syllabus uniformly.

Instruction for the candidates: The candidates are required to attempt two questions each from sections A and B of the question paper and entire section C.

SECTION-A

One Electron Atomic Spectra: Excitation of Atom with Radiation, Transition Probability, Spontaneous Transition, Selection Rules and Life Time, Spectrum of Hydrogen Atom, Bohr's Theory and Hydrogen Spectrum, Evidences in favour of Bohr's Theory, Experimental Confirmation of Bohr's Theory, Frank Hertz Experiment, Line Structure, Normal Zeeman Effect.

The Spinning Electron and the Vector Model, Electron Spin, Stern Gerlach Experiment, Spin Orbit Coupling (electron magnetic moment, total angular momentum), Fine Structure, Examples of One Electron Systems, Anomalous Zeeman Effect, Lande-g Factor (sodium D-lines), Paschen-Back Effect, Selection Rules for the Paschen-Back Effect.

SECTION-B

Many Electron System Spectra: Exchange Symmetry of Wave Functions, Exclusion Principle, Shells and Sub shells in Atoms, Atomic Spectra (Helium), LS Coupling, JJ Coupling, Terms of Equivalent and Non Equivalent Electrons, Selection Rules, Regularities in Atomic Spectra, Interaction Energy, Different Series in Alkali Spectra.

Characteristics and Continuous X-ray Spectra, Comparison of Optical and X-ray Spectra, Moseley's Law, Applications of Moseley's Law, Auger Effect, Molecular Bonding, Molecular Spectra, Selection Rules, Symmetric Structures, Rotational, Vibrational and Vibrational-rotational Electronic Levels of a Diatomic Molecule, Raman Spectra.

TEXT AND REFERENCE BOOKS

1. Introduction to Atomic Spectra by H. E. White
2. Atomic Spectra and Atomic structure by Gerhard Herzberg
3. Concepts of Modern Physics by Arthur Beiser
4. Elements of Spectroscopy by Gupta, Kumar and Sharma.

Session: 2018-2019

APPLIED OPTICS
(CODE: BPH 404)

Total Credits: 02 **Total Lectures: 30**

Maximum Marks: 50 **Pass marks: 40%**

Theory includes only qualitative explanation. Minimum five experiments should be performed covering minimum three sections.

SECTION-A

(i) Sources and Detectors

Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser,

Experiments on Lasers:

a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
c. To find the polarization angle of laser light using polarizer and analyzer
d. Thermal expansion of quartz using laser

Experiments on Semiconductor Sources and Detectors:

a. V-I characteristics of LED
b. Study the characteristics of solid state laser
c. Study the characteristics of LDR

(ii) Fourier Optics

Concept of Spatial frequency filtering, Fourier transforming property of a thin

Experiments on Fourier Optics:

a. Fourier optic and image processing

1. Optical image addition/subtraction
2. Optical image differentiation
3. Fourier optical filtering
4. Construction of an optical 4f system

b. Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science.

Experiment:

To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental

SECTION-B

(iii) Holography

Basic principle and theory: coherence, resolution, Types of holograms, white

Experiments on Holography and interferometry:

1. Recording and reconstructing holograms
2. Constructing a Michelson interferometer or a Fabry Perot interferometer
3. Measuring the refractive index of air
4. Constructing a Sagnac interferometer
5. Constructing a Mach-Zehnder interferometer

(iv) Photonics: Fibre Optics

Optical fibres and their properties, Principal of light propagation through a fibre,

Experiments on Photonics: Fibre Optics

a. To measure the numerical aperture of an optical fibre
b. To study the variation of the bending loss in a multimode fibre
c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern
d. To measure the near field intensity profile of a fibre and study its refractive index profile

Reference Books:

- Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill.
- LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
- Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
- Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
- Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
- Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
- Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
- Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press.