Courses of Study

(Detailed Course Contents)

Integrated B.Sc. (Hons.) Physics – M.Sc. Physics Programme

(2022-2023 Batch)

Semester-VI

Offered by

School of Physics

Shri Mata Vaishno Devi University

Kakryal, Katra 182320 Jammu & Kashmir

Course Structure of
Integrated B.Sc. (Hons.) Physics – M.Sc. Physics (2022-23 Batch)

Semester V **Third Year**

Course Category	Course Code	Course Name	L	T	P	Credits
Major (Theory)	PHL 3062	Elementary Statistical Mechanics	3	1	0	4
Major (Theory)	PHL 3021	Classical Mechanics	3	1	0	4
Major (Theory)	PHL 3071	Atomic and Molecular Physics	3	0	0	3
Major (Lab)	PHP 3071	Atomic and Molecular Physics Lab	0	0	2	1
Major (Theory + Lab)	PHL 3031	Introduction to Numerical Computation	3	0	2	4
Minor	PHL 3084	Fundamentals of Materials Science	4	0	0	4

Semester VI **Third Year**

Course Category	Course Code	Course Name	L	T	P	Credits
Major	PHL 3101	Introductory Solid State Physics	3	1	0	4
Major	PHL 3193	Quantum Mechanics	3	1	0	4
Major (DSE-I)	PHL 3125	Basic Experimental Techniques	4	0	0	4
Major (DSE-II)+C6	PHL 3171/ PHL 3056	Atmosphere and Space Physics/ Fundamentals of Microprocessors	4	0	0	4
Minor (Theory)	PHL 3052	Basic Circuit Theory	3	0	0	3
Minor (Lab)	PHP 3052	Basic Circuit Theory Lab	0	0	2	1

PHL 3101			Introductory Solid State Physics				Course Type		Major (Core)	
Batch			2022-23	Session		2024-25	Semester		Even	
L	T	P	C	Mid-Term Duration	Major Duration	Two Assignments (10 marks each)	Mid-Term Marks	4 Quizzes (5 marks each)	Major Marks	Total Marks
3	**1**	**0**	**4**	**1.5 hours**	**3 hours**	**20**	**20**	**20**	**40**	**100**

Unit-I **[10]**

Atomic Structure: Fundamental Concepts, Electrons in Atoms, The Periodic Table, Atomic Bonding in Solids: Bonding Forces and Energies, Primary Interatomic Bonds- Ionic Bonding, Covalent Bonding, Metallic Bonding, Secondary Bonding or van der Waals, Mixed Bonding

Unit-II **[10]**

Single Crystals, Polycrystalline Materials, Unit Cells, Crystal Lattice, Density Computations, Polymorphism and Allotropy, Crystal Systems, Point Coordinates, Crystallographic Directions, Crystallographic Planes, Linear and Planar Densities, Close-Packed Crystal Structures, Anisotropy

Unit-III **[12]**

X-ray Diffraction – Diffraction Phenomenon, Bragg's law, Laue's Equations, X-ray diffraction methods – The Laue's Method, Rotating Crystal Method, Powder Method, Reciprocal Lattice Vectors, Reciprocal Lattice to sc, bcc and fcc lattices, Properties of Reciprocal Lattice

Unit-IV **[10]**

Free electron gas (theory), density of states, and Fermi Energy, One Dimensional Lattice: Kronig-Penny Model, Bloch Theorem, Band Gap, Effective mass, TO and LO Modes

Text Book:

1. Introduction to Solid State Physics by C. Kittel

Suggested Reading(s):

2. Materials Science and Engineering by William D. Callister (Wiley 10th Ed., 2018)
3. Solid State Physics by Puri and Babbar (S. Chand & Co., Ist Ed., 2021)

PHL 3193			Quantum Mechanics				Course Type		Major (Core)	
Batch			2022-23	Session		2024-25	Semester		Even	
L	T	P	C	Mid-Term Duration	Major Duration	Two Assignments (10 marks each)	Mid-Term Marks	4 Quizzes (5 marks each)	Major Marks	Total Marks
3	**1**	**0**	**4**	**1.5 hours**	**3 hours**	**20**	**20**	**20**	**40**	**100**

Unit-I **[9]**

Wave-function in coordinate and momentum representations, Schrödinger equation (time-dependent and time-independent), Expectation Values, current density, equation of continuity, Ehrenfest's theorem.

Unit-II **[8]**

Particle in a Well (infinite and finite), harmonic oscillator, Potential Step, Potential Barrier, Rigid rotator and Hydrogen atom problem.

Unit-III **[10]**

Fundamental postulates of wave mechanics, Commutators, Hermitian operators, properties of eigen functions and eigen values of Hermitian operators, Dirac notation for state vectors (Bra and ket notations), matrix representation of wave function and operator, energy spectrum of one dimensional harmonic oscillator using matrix mechanics.

Unit-IV **[15]**

Angular momentum algebra: operators for J_+, J_- and J_Z, Commutation relation, Spectrum of eigen values of J^2 and J_Z, operators for angular momentum L in spherical polar co-ordinates, Eigen values and eigen functions of L^2 and L_Z. Spin angular momentum, Eigen values and eigen functions of S^2 and S_Z. Matrix representation of J^2, J_Z, J_+, J_-, J_x, J_y for j=1/2 and 1. Pauli's spin matrices and their properties, Addition of two angular momenta; Clebsch Gordon coefficients.

Text Book:

1. Introduction of Quantum Mechanics: D.J. Griffiths.

Suggested Reading(s):

2. Quantum Mechanics, Ghatak & Loknathan, 1st Edition, MacMillan India
3. Quantum Mechanics, L. I. Schiff, 3rd Edition, McGraw-Hill (1968).

PHL 3125			**Basic Experimental Techniques**				Course Type		**Major (DSE-I)**	
Batch			**2022-23**	Session		**2024-25**	Semester		**Even**	
L	T	P	C	Mid-Term Duration	Major Duration	Two Assignments (10 marks each)	Mid-Term Marks	4 Quizzes (5 marks each)	Major Marks	Total Marks
4	**0**	**0**	**4**	**1.5 hours**	**3 hours**	**20**	**20**	**20**	**40**	**100**

Unit-I
Physical measurement **[6]**

Measurement, result of a measurement, sources of uncertainty and experimental error, Systematic error, random error, Reliability- chi square test, Analysis of repeated measurement, Precision and accuracy, Elementary data fitting.

Unit-II
Instrumentation Electronics **[9]**

Transducers, Transducer characteristics, selection of a instrumentation transducer, Transducer as an electrical element, Signal processing – A/D conversion – multichannel analyzers– Time of flight technique

Unit-III
Vacuum Techniques **[8]**

Basic idea of conductance, pumping speed, Types of Pumps: Mechanical Pump, Turbo-molecular pump, Gauges, Thermocouple gauge, Penning gauge, Piranigauge,Hot Cathode gauge.

Unit-IV
Signal Conditioning **[12]**

Signal Conditioning, Analog signal conditioning: Operational amplifier, Instrumentation amplifiers, precision absolute value circuits, True RMS to DC converters, Phase sensitive detection: lock-in detector, box-car integrator, Spectrum analyser, Introduction to Digital signal conditioning.

Unit-V
Radiation Detectors **[10]**

Detection of X-rays, Gamma rays, charged particles, neutron, Ionization chamber, Proportional counter, GM counter, Scintillation detectors, Solid State detectors, Measurement of energy and time using electronic signals from the detectors and associated instrumentation.

Reference Books:

1. Measurement, Instrumentation and Experimental design in Physics and Engineering Michael Sayer and Abhai Mansingh, Prentice Hall of India 2005
2. Vacuum Technology, A. Roth, North Holland Amsterdam
3. Techniques for Nuclear and Particle Physics Experiments, W. R. Leo, Springer, 1994.
4. Modern Electronic Instrumentation and Measurement Techniques, Helfrick, A.D., Cooper, W.D., Prentice Hall of India (2007).

PHL 3171			**Atmosphere and Space Physics**				Course Type		**Major (DSE-II)**	
Batch			**2022-23**	Session		**2024-25**	Semester		**Even**	
L	T	P	C	Mid-Term Duration	Major Duration	Two Assignments (10 marks each)	Mid-Term Marks	4 Quizzes (5 marks each)	Major Marks	Total Marks
4	**0**	**0**	**4**	**1.5 hours**	**3 hours**	**20**	**20**	**20**	**40**	**100**

Unit-I
Essentials of Atmospheric Physics **[10]**

Structure of the atmosphere: troposphere, stratosphere, mesosphere, thermosphere, Composition of air, Greenhouse effect Transport of matter, energy and momentum in nature,.Elements of weather and climate of India.

Unit-II
Atmospheric Pollution and Degradation **[15]**

Factors governing air, water and noise pollution air and water quality standards, Waste disposal, Heat island defect, Land and sea breeze Puffs and plumes, Gaseous and particulate matters, Pollutants (different compounds), aerosols, toxic gases and radioactive particles& trace gases.

Unit-III
Ionosphere **[10]**

Formation of the Ionosphere and Its layers D,E,F (F1 &F2) Layers. Propagation of radio waves through ionosphere. Ionosphere's parameters.

Unit-IV
Space Exploration **[10]**

Techniques of space exploration, orbits of the earth, geostationary and geosynchronous orbits, Polar orbits, elliptical orbits. Remote sensing satellites, Communication satellite, CartoSats

Reference Books:

1. Source book on space science by S. Glasstone, Van Nostrand Company Incorporated, 1965
2. The Physics of Atmosphere: J.T. Houghton, Cambridge Univ. Press, 1977.
3. Atmospheric Science: John M. Wallace & Peter V. Hobbs, Academic Press (2006)

PHL 3056			Fundamentals of Microprocessors				Course Type		Major (DSE-II)	
Batch			2022-23	Session		2024-25	Semester		Even	
L	T	P	C	Mid-Term Duration	Major Duration	Two Assignments (10 marks each)	Mid-Term Marks	4 Quizzes (5 marks each)	Major Marks	Total Marks
4	**0**	**0**	**4**	**1.5 hours**	**3 hours**	**20**	**20**	**20**	**40**	**100**

Unit I **[12]**

Introduction to Microcomputer based system. History Evolution of Microprocessor and microcontrollers and their advantages and disadvantages. Architecture of 8085 Microprocessor. Address / Data Bus multiplexing and de-multiplexing, Status and Control signal generation, block diagram, pin diagram.

Unit II **[16]**

The 8085 programming model, Instruction set of 8085 Microprocessor, Classification of instructions, addressing modes, timing diagram of the instructions. Assembly language programming: Addition, Multiplication, Block Transfer, Ascending order, Descending order, Finding largest & smallest number, Look-up table etc.

Unit III **[12]**

Basic interfacing concepts, Memory interfacing, interfacing the 8155 memory segment, Interfacing output displays, interfacing input devices, Memory mapped I/O

Unit IV **[12]**

Interrupts of 8085 processor: classification of interrupts, Programming using interrupts (programming using INTR is not required). Serial and parallel data transfer – Basic concept of serial I/O, DMA, Asynchronous and synchronous serial transmission using SID and SOD pins of 8085 Microprocessor.

Prerequisites: Shall require fundamental knowledge of digital electronics fundamentals and number systems.

Reference Books:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar (Penram International)|
2. Microprocessors & interfacing – D. V. Hall (Tata McGraw-hill)

PHL 3052			Basic Circuit Theory				Course Type		Minor (Theory) Part-A	
Batch			2022-23	Session		2024-25	Semester		Even	
L	T	P	C	Mid-Term Duration	Major Duration	Two Assignments (10 marks each)	Mid-Term Marks	4 Quizzes (5 marks each)	Major Marks	Total Marks
3	**0**	**0**	**3**	**1.5 hours**	**3 hours**	**20**	**20**	**20**	**40**	**100**

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UNIT-I
Series-Parallel Networks **[10]**

Kirchhoff's laws, Ladder networks, Current sources, Conversion of current source to voltage source and vice versa, Current sources in series and parallel, Mesh analysis, Nodal analysis, Bridge networks.

UNIT-II
Network Theorems **[12]**

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Millman's theorem, Substitution theorem, Reciprocity theorem.

UNIT–III
AC Circuits **[10]**

Introduction to a.c. waveforms, Definition of terminology, Average and effective values, Introduction to phasor notation, Response of basic R, L and C elements to a sinusoidal signal, Frequency response, Power factor, Series and parallel a.c. circuits, Impedance and phase diagram, Voltage divider rule for a.c circuits, Current divider rule for a.c. circuits, Power in a.c. circuits, The power triangle.

UNIT–IV
Resonance **[10]**

Introduction to resonance, Series LCR resonant circuit, Q factor, Variation of impedance with frequency, Selectivity of a series resonant circuit, Parallel LCR resonant circuit, Qfactor, Selectivity curves, Application to tuned filters, Bode plots.

Reference Books

1. Introductory Circuit Analysis. 11th edition. Robert L. Boylestad (2006). Prentice Hall.
2. Fundamentals of Electric Circuits, 3rd Edition.Charles Alexander and MatthewSadiku (2006).McGraw Hill.
3. Electric Circuit Fundamentals (7th Edition). Thomas L. Floyd (2006).Prentice Hall.
4. Circuit Theory - Analysis and Synthesis, A. Chakrabarti, (2018), DanpatRai& Co.

PHP 3052			**Basic Circuit Theory Lab**				Course Type		**Minor (Lab) Part-B**	
Batch			**2022-23**	Session		**2024-25**	Semester		**Even**	
L	T	P	C	Major Duration		Lab File (20 marks) + Attendance (10 marks)		Viva	Major Marks	Total Marks
0	**0**	**2**	**1**	**2 hours**		**30**		**30**	**40**	**100**

Choose any 6 experiments from the list given below:

1. To verify Kirchhoff’s Laws (KCL/ KVL).
2. To verify Thevenin’s theorem
3. To verify Norton’s theorem.
4. To verify maximum power transfer theorem.
5. To verify superposition theorem
6. To study of the rise and decay of current in RC circuit.
7. To study of the rise and decay of current RL circuits.
8. To study frequency response of series LCR Circuit and to determine its (a) resonant frequency and (b) the Q-factor.

9. To study frequency response of parallel LCR Circuit and to determine its (a) anti-resonant frequency and (b) the Q-factor.

Reference Books:

1. Practical Physics by G L Squires Cambridge University Press.
2. Advanced Practical Physics for Students by Worsnop and Flint.
3. Practical Physics by R K Shukla.
4. B.Sc Practical Physics by Harnam Singh.
5. B. Sc Practical Physics by C. L. Arora.
6. An Advanced Course in Practical Physics by D. Chattopadhyay, P.C. Rakshit.
7. A Text Book of Practical Physics, S.K. Ghosh, 2015, New Central Book Agency.

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Published by: Shri Mata Vaishno Devi University, Katra J&K 182 320