

Courses of Study

(Detailed Course Contents)

**Integrated B.Sc. (Hons.) Physics – M.Sc. Physics
Programme
(2023-2024 Batch)
Semester-IV**

**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 (2023-24 Batch)**

Semester III

Second Year

Course Category	Course Code	Course Name	L	T	P	Credits
Major (Theory)	PHL MD201	Analog Electronics	3	0	0	3
Major (Lab)	PHP MD201	Analog Electronics Lab	0	0	2	1
Major (Theory)	PHL MD203	Mathematical Methods-I	3	1	0	4
Minor (Theory)	PHL MI205	Waves and Oscillations	3	0	0	3
Minor (Lab)	PHP MI205	Waves and Oscillations Lab	0	0	2	1
Multidisciplinary		To be chosen from the other schools				4
AEC		To be chosen from the basket of courses	2	0	0	2
SEC		To be chosen from the basket of courses	2	0	0	2

Semester IV

Second Year

Course Category	Course Code	Course Name	L	T	P	Credits
Major (Theory)	PHL MD202	Digital Fundamentals	3	0	0	3
Major (Lab)	PHP MD202	Digital Fundamentals Lab	0	0	2	1
Major (Theory)	PHL MD204	Mathematical Methods-II	3	1	0	4
Major (Theory)	PHL MD206	Elementary Nuclear Physics	4	0	0	4
Major (Theory)	PHL MD208	Foundations of Modern Physics	4	0	0	4
Minor (Theory)	PHL MI206	Measurement and Analysis	2	0	0	2
Minor (Lab)	PHP MI206	Measurement and Analysis Lab	0	0	4	2

Multidisciplinary course - III (Sem-III)

Course Code	Course Title	L-T-P	Credits
PHL MU201	Elements of Thermodynamics	3-1-0	4

Skill Enhancement course – SEC-III (for other schools)

Course Code	Course Title	L-T-P	Credits
PHM SE201	Physics Skills in Experimentation	1-0-2	2

PHL MD202				Digital Fundamentals			Course Type		Major (Core) Part-A	
Batch				2023-24	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

UNIT-I

Number Systems and Logic Gates

[12]

Number systems and their conversions: Decimal, binary and hexadecimal, binary arithmetic, binary coded decimal, Logic Gates – NOT, AND, OR, NAND, NOR, EX-OR and EX-NOR, Universal property of NAND and NOR gates.

UNIT-II

Boolean Algebra and Logic Simplification

[12]

Boolean operations and expressions, Laws of Boolean algebra, DeMorgan's Theorems, Boolean analysis of logic circuits, Logic simplification using Boolean algebra, Standard forms of Boolean expressions, Boolean expressions and truth tables.

UNIT-III

Combinational Logic

[11]

Basic combinational logic circuits, Combinational logic using NAND and NOR gates, Half and Full adders, Parallel binary adders, comparators, decoders, encoders, multiplexers, de-multiplexers, parity generators/ checkers.

Unit-IV

Sequential logic

[8]

Latches, Flip-Flops- Operating characteristics and applications, one-shots, Astable multivibrators

Reference Books:

- Digital Fundamentals: Floyd 11(e), Pearson (Textbook).
- Modern Digital Electronics: R.P. Jain, 4e (2009), TMH.

PHP MD202				Digital Fundamentals Lab			Course Type		Major (Core) Part-B	
Batch				2023-24	Session	2024-25	Semester			
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	

Every student must perform at least 5 experiments as listed below, however additional experiments can be identified by the course coordinator to complete this requirement.

- To study performance of a NOT circuit.
- To verify De Morgan's theorem and some relationships in Boolean algebra.
- To design OR & AND logic with diode and resistor.
- To realize basic logic gates with any type of universal gate NAND/NOR.
- To form different combinational problems by construction of Truth Table and implement it using basic logic gates.
- To design half adder circuit and to verify its truth table.
- To design full adder circuit and to verify its truth table.
- To design half subtractor, full subtractor, adder-subtractor using full adder.
- To construct i) RS ii) D, and JK FF circuits using NAND gates.

Suggested Books:

1. Digital Fundamentals: Floyd 11(e), Pearson.
2. Modern Digital Electronics: R.P. Jain, 4e (2009), TMH Advanced Practical Physics for Students by Worsnop and Flint.
3. Basic Electronics-A text Lab Manual, Zbar&Malvino, (Tata McGraw-Hill, 1999).

PHL MD204				Mathematical Methods-II			Course Type		Major (Core)	
Batch			2023-24	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

Linear Differential Equations of Second Order

[12]

Second order linear and no-linear differential equations with constant coefficients, Non-homogeneous and Homogeneous differential equations, Methods to find the complementary function and particular integral.

UNIT-II

Double and Triple Integrals

[12]

Evaluation of double integration in Cartesian and Polar coordinates, Applications of double integrals in finding area, centre of gravity, mass and volume, Triple integration in Cartesian and Polar coordinates, Applications of triple integrals in calculating volume, area, centre of gravity, mass and moment of inertia

UNIT-III

Fourier Series

[10]

Periodic functions, Fourier Series, Dirichlet's condition, Useful integrals, Determination of Fourier Coefficients, Fourier series for discontinuous functions, Even and Odd functions, Half-range series, Half period series, Parseval's formula, complex form of fourier series

UNIT-IV

Special Functions

[11]

Legendre's and Hermite functions- Equation, Polynomials, General solution, Generating function, Orthogonality, Recurrence formulae for each

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber and Harris (7e) (Textbook)
2. Mathematical Physics: Dass and Verma, S. Chand (8e) 2018

PHL MD206			Elementary Nuclear Physics				Course Type		Major (Core)	
Batch			2023-24	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

General Properties of Nuclei

[12]

Basic nuclear properties: Size Measurement of Nuclear Radius by Electron Scattering method and Mirror Nuclei method, Nuclear Density, Packing Fraction, Mass Defect, Binding energy, Discussion of Average Binding energy curve, Nuclear Stability, N/Z plot, angular momentum, parity, magnetic moment, electric moments, nuclear excited states.

Unit-II

Nuclear Models

[12]

Liquid drop model approach, Weizsacker's Semi-Empirical Mass Formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas, Nuclear Forces and their properties (qualitative treatment))

Unit-III

Radioactivity and Nuclear Decays

[12]

Laws of radioactive decay, Radioactive Series, Alpha Decay (qualitative treatment), Discrete Nature of α -particle energies, Measurement of velocity of α -particle, Beta Decay, Beta particle energy spectrum, Pauli's theory of Neutrino, Inverse Beta decay, Simple idea about Gamma Decay.

Unit-IV

Nuclear Reactions

[12]

Types of Nuclear Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, Coulomb scattering (Rutherford scattering).

Unit-V

Particle Physics

[12]

Classification of elementary particles, Strangeness, Baryon Number and Isospin, Parity Quantum Number, Gell-Mann and Nishijima Scheme, Quark as the basic constituent of matter, quark properties, Quark contents in low lying Baryons and Mesons, Fundamental Forces (Strong, Weak and Electromagnetic and their characteristics).

Reference Books:

1. Introductory Nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Nuclear Physics, S. N. Ghoshal (S. Chand Publishing, 2019).

PHL MD208			Foundations of Modern Physics				Course Type		Major (Core)		
Batch			2023-24		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

Special Theory of Relativity

[12]

Postulates – Lorenz transformations – Time dilation – Length contraction – Doppler effect – Twin paradox – velocity addition – relativistic momentum – Mass energy equivalence – Electricity and Magnetism in relativity – Introduction to general relativity.

Unit – II

Matter and Radiations

[12]

EM waves – Black body radiation – Photoelectric effect – X-rays – Diffraction of x-rays– Compton effect – de Broglie waves – Phase and group velocities – Electron diffraction – Uncertainty principle.

Unit-III

Quantum mechanics

[12]

Wave equation – Schrödinger equation – Operators – Postulates of quantum mechanics – Particle in a box – Finite potential well – Introduction to quantum tunneling – Harmonic oscillator.

Unit-IV

Hydrogen atom

[12]

Schrödinger equation – Separation of variable – Quantum numbers – Quantization of energy – Angular momentum – Electron Probability density, Radiative transitions, Selection Rules, Zeeman effect.

Unit-V

Atomic structure

[12]

Electron orbits – Atomic spectra – Bohr atom – Energy levels and spectra – Absorption spectra – Finite nuclear mass correction, Sommerfeld model – Bohr's quantization rule, Bohr's correspondence principle, Vector atom model, L-S and j-j coupling.

Suggested books:

1. Concepts of Modern Physics, Arthur Beiser, Tata McGraw Hill, (2002), 6th Edition.
2. Introduction to Modern Physics, H. S. Mani and G. K. Metha, Affiliated East-West Press, (1988).

PHL MI206			Measurement and Analysis				Course Type		Minor Part-A	
Batch			2023-24	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
2	0	0	2	1.5 hours	3 hours	20	20	20	40	100

UNIT-I

Some Laboratory Instruments and Methods

[5]

Metre rule, Micrometer screw gauge, Measurement of length, Measuring frequency, Negative feedback amplifier, Servo systems, Natural limits of measurements

UNIT-II

Experimental Techniques and Logic

[10]

Rayleigh refractometer, Measurement of resistivity, Measurement of 'g', Measurement of frequency and time, The Global positioning system, Sequence of measurements, Drift, Systematic variations, Relative methods, Null methods, Repetition of measurements

UNIT-III

Uncertainty in Measurements

[5]

Measuring errors, Systematic and random errors, Set of measurements, Distribution of measurements, Estimation of σ and σ_m , Propagation of errors

UNIT-IV

Data Handling

[10]

Parent and Sample Distributions, Mean and Standard Deviation of Distributions, The Gaussian distribution, The integral function, The treatment of functions, Method of least squares for fitting a straight line

Suggested Books:

1. Practical Physics: G. L. Squires (4e) Cambridge University Press, 2001 (Textbook).
2. Data Reduction and Error Analysis for Physical Sciences: Bevington and Robinson (3e) McGraw Hill, 2003

PHP MI206			Measurement and Analysis Lab				Course Type		Minor Part-B	
Batch			2023-24	Session	2024-25	Semester				
L	T	P	C	Major Duration	Lab File (20 marks) + Attendance (10 marks)	Viva	Major Marks	Total Marks		
0	0	4	2	2 hours	30	30	40	100		

Choose any 5 experiments from the list given below:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/frequency counter.
6. Measurement of rise, fall and delay times using a CRO.

7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Suggested Readings:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
5. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill



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