Syllabus for
Master of Science (FYIP) Physics

(Semester I -IV)
(Under Credit Based Continuous Evaluation Grading System)
(12+3+2 System of Education)
Session: 2025-26

Kanya Maha Vidyalaya, Jalandhar
(Autonomous)
The Heritage Institution

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (FYIP) Physics

Session-2025-26

Semester-I									
Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Exam time in Hours)
					Total	Ext		CA	
				L-T-P		L	P		
1.	FPHL-1421 FPHL-1031 FPHL-1431	C	Punjabi(Compulsory) [1]Basic Punjabi [2]Punjab History and Culture	2-0-0	50	35		15	3
2.	FPHL-1102	AEC	Communicative English-I	2-0-0	50	35		15	3
3.	FPHL-1393	DSC	Mechanics	4-0-0	100	70	-	30	3
4.	FPHL-1394	DSC	Thermal Physics	4-0-0	100	70	-	30	3
5.	FPHL-1335	C	Mathematical Physics-I	4 -0-0	100	70	-	30	3
6.	FPHM-1086	E**	Organic Chemistry	3-0-1	100	40	30	30	3+3
7.	FPHM-1126	E**	Computer Fundamentals and PC Software	3-0-1	100	40	30	30	3+3
8.	FPHP-1397	DSC	Physics Lab-I	0-0-3	100	-	70	30	3
10.	VACF-1491	VAC	*Foundation Course	2-0-0	50	35		15	1
Total credits				25	650				

[1] **Special paper in lieu of Punjabi (Compulsory) for those who have not studied Punjabi upto 8th/ 10th Class. .**

[2] **Special paper in lieu of Punjabi (Compulsory) for those students who are not domicile of Punjab.**

***credits/ grade points of these courses will not be added in SGPA/ CGPAof the semester/ Programme and only grades will be provided.**

****** **Students will opt any one course.**

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME
Master of Science (FYIP) Physics
Session-2025-26
Semester II

Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Examination time in Hours)
					Total	Ext		CA	
				L-T-P		L	P		
1	FPHL-2421 FPHL-2031 FPHL-2431	C	Punjabi(Compulsory) [1]Basic Punjabi [2]Punjab History and Culture	2-0-0	50	35	-	15	3
2	FPHL-2102	AEC	Communicative English-II	2-0-0	50	35	-	15	3
3	FPHL-2393	DSC	Electricity and Magnetism	4-0-0	100	70	-	30	3
4	FPHL-2394	DSC	Waves and Oscillations	4-0-0	100	70	-	30	3
5.	FPHL- 2335	C	Mathematical Physics-II	4-0-0	100	70	-	30	3
6	FPHM-2086	E**	Inorganic Chemistry	3-0-1	100	40	30	30	3+3
7.	FPHM-2126	E**	Introduction to Programming in C	3-0-1	100	40	30	30	3+3
8	FPHP-2397	DSC	Physics Lab-II	0-0-3	100	-	70	30	3
9.	VACD-2161	VAC	*Moral Education with focus on Drug Abuse and Human Rights (Compulsory)	2-0-0	50	35	-	15	3
			Total Credits	25	650				

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Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (FYIP) Physics

Session-2025-26

Semester-III

Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Exam time in Hours)
					Total	Ext		CA	
						L	P		
1.	FPHL-3391	C	Electromagnetic Theory	4-0-0	100	70	-	30	3
2.	FPHL-3392	C	Optics	4-0-0	100	70	-	30	3
3.	FPHL-3173	C	Statistics	4-0-0	100	70	-	30	3
4.	FPHL-3394	MDC	Introduction to Glass Science and Glass Ceramics	3-0-0	100	70	-	30	3
5.	FPHM-3125	E**	Python Programming	3-0-1	100	40	30	30	3+3
6.	FPHM-3085	E**	Physical Chemistry	3-0-1	100	40	30	30	3+3
7.	FPHP-3396	C	Physics Lab-III	0-0-3	100	-	70	30	3
8.	*VACG-3531	VAC	Gender Sensitization	2	50	35		15	1
Total Credits				24	650				

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***credits/ grade points of these courses will not be added in SGPA/ CGPAof the semester/ Programme and only grades will be provided.**

****** Students will opt any one course.**

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (FYIP) Physics

Session-2025-26

Semester IV

Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Examination time in Hours)
					Total	Ext		CA	
						L	P		
1.	FPHL-4391	C	Analog Systems & Applications	4	100	70	-	30	3
2.	FPHL-4392	C	Elements of Modern Physics	4	100	70	-	30	3
3.	FPHL- 4393	DSC	Special Theory of Relativity	4	100	70	-	30	3
4.	FPHM-4085	E**	Introduction to Molecular Spectroscopy & Quantitative estimation methods	3-0-1	100	40	30	30	3+3
5.	FPHM-4125	E**	R PROGRAMMING	3-0-1	100	40	30	30	3+3
6.	FPHP-4396	C	Physics Lab-IV	3	100	-	70	30	3
7.	FPHL-4390	SEC	Medical Physics	3	100	70		30	3
8..	*VACE-4221	VAC	Environment studies	2	50	20	15	15	3
Total Credits				24					

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**** Students will opt any one course.**

PROGRAM SPECIFIC OUTCOMES (PSOs)

Programme Specific Outcomes of Master of Science (Five Year Integrated Programme) Physics (M.Sc. (FYIP) Physics)

PSO1: Scientific Knowledge and Conceptual Clarity

Acquire a systematic and conceptual understanding of fundamental and advanced principles of sciences.

Demonstrate familiarity with key domains such as electromagnetism, quantum mechanics, modern physics, classical mechanics, optics, and medical physics.

Apply foundational concepts to explain scientific phenomena.

PSO2: Problem-Solving and Analytical Skills

Develop the ability to analyze physical systems quantitatively and qualitatively using scientific reasoning and mathematical modeling.

Solve numerical problems using techniques from differential equations, linear algebra, calculus, and vector analysis.

Formulate and analyze physical problems in nuclear, atomic, and medical physics using logical and computational approaches.

PSO3: Practical and Laboratory Skills

Gain hands-on experience in performing physics experiments related to electronics, optics, atomic physics, and electromagnetic theory.

Use modern instrumentation and data analysis techniques such as spectrometers, oscilloscopes, detectors, dosimeters, and computer-based simulations.

Interpret experimental data, evaluate uncertainties, and validate theoretical predictions through empirical methods.

PSO4: Programming and Computational Thinking

Learn programming languages like Python and R for data analysis, simulations, and automation of experimental procedures.

Use computational tools for solving physical problems involving large datasets, simulations (e.g., Monte Carlo), and graphical visualizations.

Apply code-based solutions in modern research areas such as quantum computation, medical imaging, and statistical physics.

PSO5: Communication and Documentation

Communicate scientific ideas clearly in oral and written formats to both scientific and non-scientific audiences.

Prepare lab reports, project presentations, scientific posters etc using proper scientific conventions.

Interpret and explain graphical data, simulation results, and mathematical derivations effectively.

PSO6: Application of Science in society and Industry

Apply physics principles to develop solutions for society and industry .

Understand industrial applications of physics in electronics, optics, nuclear energy, and environmental monitoring.

Use interdisciplinary knowledge to address real-world problems through scientific intervention, research and technological advancement.

PSO7: Lifelong Learning and Career Readiness

Continuously upgrade skills and knowledge in response to emerging trends in physics, computational methods, and medical technologies.

Prepare for competitive exams (e.g., GATE, NET, JAM) or pursue further education and research in core and applied physics.

Develop adaptability to work in academic, research, clinical, or industrial environments with confidence.

PSO8: Teamwork and Multidisciplinary Collaboration

Collaborate effectively in multi-disciplinary teams, especially in areas like biomedical engineering, software development, and healthcare innovation.

Share knowledge, divide responsibilities, and integrate diverse skills to achieve common goals in laboratory and project settings.

Foster interpersonal skills to work constructively with peers, faculty, and industry professionals.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: MECHANICS

COURSE CODE: FPHL-1393

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Understand the concept of inertial frames and calculations of displacement, velocity and acceleration in various coordinate systems. Students will be able to know the laws of motion and relative motion by using Galilean transformations. They will learn various conservation laws and their application to variable mass systems.

CO2: They will understand elastic scattering in the lab and centre of mass systems. They will understand the physics of the rotational motion of a body by studying Euler's equations and the Moment of inertia tensor.

CO3: Learn the effects of gravitational force and other fundamental forces of nature. They will learn the concept of the centre of mass, central forces, and the motion of particles under a central force, as well as determine the turning points of orbit. They will be able to understand planetary motion by solving differential equations of orbits and studying Kepler's laws.

CO4: They will understand the origin of fictitious forces in non-inertial frames and their consequences on acceleration due to gravity, the motion of a particle on earth, and Foucault's pendulum as a real-life illustration of fictitious forces.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: MECHANICS

COURSE CODE: FPHL-1393

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks. **Note:** Students can use Non-Scientific calculators or logarithmic tables.

Unit- I

Co-ordinate Systems and Motion of a particle: Reference frames, Inertial frames; Displacement, velocity& acceleration in Cartesian, Plane polar, Spherical& Cylindrical coordinate systems Area and Volume in these coordinate systems. Solid angle. Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance of space &time intervals, Newton's laws of motion and conservation laws.

Fundamentals of Dynamics: Momentum of variable-mass system: motion of the rocket. Dynamics of a system of particles: internal & external forces and momentum conservation, Centre of Mass, Impulse.

Unit- II

Collisions: Elastic and inelastic collisions between particles, Relationship of velocities, angles and energiesof the colliding particles in the Centre of Mass and Laboratory frames.

Rotational Dynamics: Angular momentum of a particle and system of particles and torques due to internal forces. Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia.Kinetic energy of rotation, Motion involving both translation and rotation, Rotational motion of a rigid body in general, Rotation of angular momentum vector about a fixed axis, Angular momentum and kinetic energy of a rigid body about principal axes, Euler's equations, Precession and Elementary Gyroscope.Motion of a spinning top.

Unit- III

Gravitation Fields and Potentials: Law of gravitation. Gravitational potential energy, Inertial and gravitational mass. Potential energy and force between a point mass and spherical shell, a point mass and solid sphere. Gravitational and electrostatic self-energy, Gravitational energy of uniform sphere.

Central Force Motion: Forces in nature (Qualitative). Conservative forces. Central Forces.Motion of a particle under a central force field, Two-body problem and its reduction to one-body problem and its solution, Reduced mass, Equation of motion of a reduced mass under central force and energy. Differential equation of the orbit, Equation of orbit under inverse square force field, turning points, Kepler's Laws, Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.

Unit- IV

Non-Inertial Systems: Non-inertial frames. Fictitious forces in non-inertial frames having translational and uniform rotational motion. Laws of Physics in rotating coordinate systems. Centrifugal force. Effect of rotation of earth on acceleration due to gravity, Effect of Coriolis force on a particle falling freely under gravity.Effect of Coriolis force on a particle moving on the surface of earth, Foucault's pendulum and its equation of motion.

Reference Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 2012, McGraw-Hill.
2. Mechanics, Berkeley Physics, Vol.1, C.Kittel, W.Knight, et. al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 9/e. 2010, Wiley.
4. Analytical Mechanics, G.R.Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol.1, R.P. Feynman, R.B. Leighton, M.Sands, 2008, Pearson Education.
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: THERMAL PHYSICS

COURSE CODE: FPHL-1394

COURSE OUTCOMES

After passing this course the students will be able to:

CO1: Understand thermodynamic systems, properties, and equilibrium. Apply energy conservation principle through the First Law. Analyze heat and work interactions. Explore reversible and irreversible processes, Carnot cycle, and efficiency. Grasp the Second Law and its implications for temperature scales and thermodynamic processes.

CO2: Comprehend entropy, its implications on thermodynamic processes, and the Second Law. Analyze thermodynamic potentials, their properties, and applications in various systems. Apply thermodynamic concepts to phase transitions and equilibrium conditions.

CO3: Apply Maxwell's relations to derive thermodynamic properties and relationships. Analyze gas behavior using Maxwell-Boltzmann distribution, equipartition theorem, and degrees of freedom. Connect theoretical concepts to experimental observations and real-world applications.

CO4: Understand and differentiate between free expansion and throttling processes. Apply Joule-Thomson effect to real gases, including inversion temperature and cooling. Analyze adiabatic demagnetization as a cooling technique.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: THERMAL PHYSICS

COURSE CODE: FPHL-1394

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT–I

Law of Thermodynamics: Extensive and Intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamic & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential Form, Internal Energy, First Law & Various Processes, Applications of First Law: General Relation between CpAndCv, Work Done during Isothermal and Adiabatic Processes, Carnot engine & efficiency, Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Application of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thernodynamics in terms of Entropy, Entropy of a perfect gas, Principle of increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy Changes in Reversible and Irreversible Processes, Principle of Increase of Entropy, Temperature-Entropy diagrams for Carnot's Cycle, Third Law of Thermodynamics Unattainability of Absolute Zero

UNIT–II

Thermodynamic Potentials & Maxwell's Thermodynamic Relations: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Their Definitions, Properties and Applications, Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4)

Surface Films and Variation of Surface Tension with Temperature, (5) Energy Equations, (6) Change of Temperature during Adiabatic Process.

UNIT–III

Magnetic Work, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. Joule's Experiment Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment Joule Thomson Effect for Ideal and Van der Waal Gases. Temperature of Inversion. Joule Thomson Cooling.Adiabatic demagnetization.

UNIT–IV

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in anIdeal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines andStern's Experiment Mean, RMS and Most Probable Speeds.Degrees of Freedom Law of Equi-partition of Energy. Specific heats of Gases

Text and Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Heat Thermodynamics & Statistical Physics, Brij Lal and Subramaniam, 1st Edn., 2008, S. Chand.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: MATHEMATICAL PHYSICS-I

COURSE CODE: FPHL-1335

CO1: Understand the concept of function plotting and series approximations using Taylor and binomial series. Students will learn to solve first-order differential equations (separable, homogeneous, exact/inexact) and second-order linear differential equations using operator methods and Wronskian concepts.

CO2: They will learn advanced techniques for solving second-order differential equations using the methods of undetermined coefficients and variation of parameters. Students will also understand Euler's differential equations and solve systems of simultaneous differential equations. Additionally, they will grasp fundamental concepts of vector algebra including scalar and vector products and their geometric interpretations.

CO3: Learn the basics of vector calculus including directional derivatives, gradient, divergence, curl, and Laplacian. Students will understand and apply vector identities and evaluate double and triple integrals, including change of order and Jacobians.

CO4: They will apply vector integration to compute line, surface, and volume integrals. Students will understand and verify the Gauss divergence theorem, Green's theorem, and Stokes' theorem. They will also learn the formulation of vector operators in orthogonal curvilinear coordinate systems like Cartesian, spherical, and cylindrical.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: MATHEMATICAL PHYSICS-I

COURSE CODE: FPHL-1335

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Unit-I

Calculus:Plotting of functions. Approximation: Taylor and binomial series (statements only). First Order Differential equations (variable separable, homogeneous, non- homogeneous),exact and inexact differential equations and Integrating Factor.

Second Order Differential equations-1: Homogeneous Equations with constant coefficients. Wronskian and general solution.Particular Integral with operator method

Unit-II

Second Order Differential equations-2: Method of undetermined coefficients and variation method of parameters. Euler differential equation and simultaneous differential equations of First and Second order.

Vector Algebra: Properties of vectors. Scalar product and vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Unit III

Vector Calculus:Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation.Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

Vector Integration-1: Ordinary Integrals of Vectors. Double and Triple integrals, change of order of integration, Jacobian.Notion of infinitesimal line.

Unit IV

Vector Integration-2: Surface and volume elements.Line, surface and volume integrals of Vector fields Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their verification (no rigorous proofs).

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Reference Books:

1. Mathematical Methods for Physicists,G.B.Arfken, H.J.Weber, F.E.Harris,2013, 7^{th} Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A.Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Advanced Engineering Mathematics,D.G.Zill and W.S.Wright, 5 Ed.,2012,Jones and Bartlett Learning
5. Mathematical Physics, Goswami, 1st edition, Cengage Learning

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: ORGANIC CHEMISTRY

COURSE CODE: FPHM-1086

Course outcomes:

After Completing the Course the students will be able to

CO1: learn about the basic chemistry of organic chemistry.

CO2: interpret the reactions and properties of alcohols and Phenols and provide basic knowledge of organic reaction mechanisms.

CO3: understand preparations and reactions of ethers and epoxides, understand cleavages in ethers, the ring opening reactions of epoxides.

CO4: to resolve the different enantiomers and differentiate between dextrorotatory-leavorotatory chiral and achiral compounds, understand the concept of isomerism, conformation and configuration.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: ORGANIC CHEMISTRY

COURSE CODE: FPHM-1086

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters: Eight questions of equal marks (Sixteen marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 14 marks.

UNIT-I

Basics concepts of Organic Chemistry: Classification and Nomenclature of organic compounds. Electronic Effects: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation. Reactive intermediates: carbocations, carbanions, free radicals. Electrophiles and Nucleophiles. Nucleophilicity and basicity. Relative strengths of acids and bases, concept of p*K*a, effect of substituents and steric effects of substituents.

UNIT-II

Chemistry of functional groups–I: Selective methods of preparation: dehydration of alcohols, dehydrohalogenation of alkyl halides with complete mechanistic discussion. (E mechanism), Saytzeff's rule. Reactions: addition of hydrogen halides (Markovnikov's and anti-Markovnikov's addition), halogen addition to alkenes, epoxidation of alkenes. Acidity of acetylene, Birch reduction, addition of hydrogen halides and water to alkynes, Diels-Alder reaction.

UNIT-III

Chemistry of functional groups–II: Ethers and Epoxides: methods of their formation, Chemical reactions Cleavage and autoxidation, Zeisel's method, Acids and base catalysed ring opening of epoxide, Alkyl Halides, Types of Nucleophilic Substitution (SN1, SN2) reactions, solvent effect, substitution and elimination as competing reactions. Principles of nucleophilic addition to carbonyl groups: acetal formation, cyanohydrins formation; reactions with primary and secondary amines, Witting reaction, aldol condensation

UNIT-IV

Stereochemistry: Introduction, Conformations of ethane and butane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Configuration: Geometrical and Optical isomerism, Molecular chirality, optical activity, absolute and relative configuration, the Cahn-Ingold Perlog R-S notional system, physical properties of enantiomers, naming stereo isometric alkenes by the E/Z system.

Books suggested

1. R.T. Morison and R.N Boyd, Organic Chemistry.

2. I.L. Finar, Organic Chemistry, Vol. I- IV

3. J. March, Advanced Organic Chemistry, Reactions Mechanism and Structure.

4. F.A. Carey, Organic Chemistry.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: Organic Chemistry (LAB)

COURSE CODE: FPHM-1086

Course Outcomes

Students will be able to analyze the given organic compound through

CO1: understand the basics of Qualitative analysis

CO2: detection of elements (N, S and halogens) in organic compounds.

CO3: detection of functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds

CO4: preparation of their derivatives

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: Organic Chemistry (LAB)

COURSE CODE: FPHM-1086

Credits: 3-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

General Guidelines for Practical Examination

The preliminary examination of physical and chemical characteristics (Physical state, colour and odour), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions, classification tests involving functional reactivity other than acid-base test. The following categories of compounds should be analysed: phenols, carboxylic acids, carbonyl compounds- ketones and aldehydes, aromatic amines, amides.

Suggested Book:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5 th Ed. Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS and

PC SOFTWARE (THEORY)

COURSE CODE: FPHM-1126

Course Outcomes:

CO1: Understand the basic concepts of computers including their generations, classifications, and applications. Students will be able to identify the functional units of a computer system and explain the interrelation between hardware and software using block diagrams of CPU, memory, input/output, and communication devices.

CO2: Students will understand the types and functions of system and application software, various programming languages, and hardware devices. They will be able to identify and describe the working of input, output, and storage devices along with their classifications such as impact/non-impact printers and magnetic/optical storage media.

CO3: Learn the purpose and types of operating systems including Windows GUI and command-line interfaces. Students will be able to perform basic to advanced tasks in word processor such as document formatting, inserting elements, using macros, mail merge, and printing setup for professional document creation.

CO4: They will understand the structure and design of presentations using slideware, including inserting multimedia and formatting slides. They will also learn to use spreadsheet for data organization, formula application, data analysis using functions, charts, and pivot tables.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS and PC SOFTWARE (THEORY)

COURSE CODE: FPHM-1126

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters: Eight questions of equal marks (Sixteen marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Unit-I

Introduction to Computer, Generations of Computers, Classification of Computers, Computer Applications: Computer as a system, basic concepts– hardware and software, functional units, and their interrelation. Block diagram showing Central Processing Unit, Memory, and Input/Output Devices, Communication devices.

Unit-II

Software: System software and Application software. Programming languages. Hardware: Input Devices- Keyboard, mouse, pens, touch screens, Bar Code reader, joystick, source data automation, (MICR, OMR, OCR), screen assisted data entry: portable/handheld terminals for data collection, voice recognition systems Output Devices: Display Monitors, Printers, Impact Printers, Non-impact Printers, Plotters, Voice Output Systems, Projectors, Terminals. Storage Devices: Concept of storage units (bit, byte, KB, MB etc.), Primary storage, Secondary storage, Magnetic storage devices, and Optical Storage Devices.

Unit-III

Operating System: meaning, purpose, Windows GUI, Command-line, Powershell overview. File, Word Processor: Overview, creating, saving, opening, importing, exporting and inserting files, formatting pages, paragraphs and sections, indents and outdents, creating lists and numbering. headings, styles, fonts and font size; editing, positioning, and viewing texts; finding and replacing text; inserting page breaks, page numbers, bookmarks, symbols, and dates; using tables, header, footer, macros, mail-merge; printing setup

Unit-IV

Slideware: Presentation overview, entering information, presentation creation, opening and saving presentation; inserting audio and video, shapes, different views, formatting; playing slides. Spreadsheet overview, Editing, Formatting, freeze panes, using formulas and functions, sorting and filtering, pivot tables, charts and Graphs.

Recommended Books:

1. P.K. Sinha, Computer Fundamentals : concepts, systems and applications, BPB Publications

2. E Balagurusamy, FUNDAMENTALS OF COMPUTERS Tata McGraw Hill Education Private Limited New Delhi.

3. Peter Norton, Introduction to Computers, McGraw Hill Education

4. MS–Office _ BPB Publications.

5. Gurvinder Singh & Rachpal Singh, Windows-Based Computer Courses.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS & PC SOFTWARE (PRACTICAL)

COURSE CODE: FPHM-1126

Course Outcomes:

CO1: Use Windows OS through GUI and command line for system navigation and file management.

CO2: Create and format documents using advanced features of word processor.

CO3: Organize and analyze data using formulas, functions, and tools in spreadsheets.

CO4: Design interactive presentations using multimedia and formatting features in slideware.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS & PC SOFTWARE (PRACTICAL)

COURSE CODE: FPHM-1126

Credits: 3-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar. Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva should also be conducted alongside, and the student is asked viva questions related to the question and the solution he/she is working on during the exam. Students will prepare a report after analyzing print and social media advertisements along with the local market survey to understand the desktop/laptop vendors and prices. Arrange the options available as per price/performance preferences.

Lab exercises based on:

1. Practice the Windows Operating System command line and the GUI for user interaction, personalization and file management
2. Document preparation with word processor using the features mentioned in the syllabus
3. Spreadsheet processing with spreadsheet using the features mentioned in the syllabus
4. Presentation preparation with slideware using the features mentioned in the syllabus

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: PHYSICS LAB-I

COURSE CODE: FPHP-1397

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Students will demonstrate the ability to conduct a specific experiment from a given list, applying theoretical knowledge and practical skills to accurately complete the procedure and obtain reliable results.

CO2: Students will be able to articulate the theoretical background and principles underlying the chosen experiment.

CO3: Students will demonstrate their understanding of the experiment through oral questioning and discussion.

CO4: Students will maintain a well-organized and accurate practical file documenting all experiments conducted.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–I)

COURSE TITLE: PHYSICS LAB-I

COURSE CODE: FPHP-1397

Credits: 0-0-3 **Max Marks: 100 (ESE Marks: 70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions to Practical Examiner: Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:
i) One experiment 30 Marks
ii) Brief Theory 15 Marks
iii) Viva–Voce 15 Marks
iv) Record (Practical file) 10 Marks
II. There will be one session of 3 hours duration. The paper will have one session and 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.
III. Number of candidates in a group for practical examination should not exceed 20.
IV. In a single group no experiment be allotted to more than three examinee in any group.

LIST OF EXPERIMENTS

1. Use of Vernier calliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To find Young's modulus of the material of a rectangular bar by bending.
4. To determine the Modulus of Rigidity of a Wire by Maxwell‟s needle.
5. To determine the value of g using Bar Pendulum.
6. To determine the value of g using Kater‟s Pendulum.
7. To find the efficiency of an electric kettle with varying input voltage.
8. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton disc method.
9. To determine Stefan's constant using Boltzmann's law.
10. To Study the variation of Thermo-Emf of a thermocouple with difference of temperature of its two Junctions using a null method and also calibrate the thermocouple in a specified temperature range.
11. To find unknown low resistance using Carey Foster's bridge without calibrating the bridge-wire.

Reference Books:

1. Practical Physics, C.L. Arora, S. Chand & Co.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: ELECTRICITY AND MAGNETISM

COURSE CODE: FPHL-2393

COURSE OUTCOMES

Course Outcomes: Electricity and Magnetism

After passing this course the students will be able to:

CO1: understand vector calculus and vector algebra and its applications in electricity and magnetism. The students will be able to solve the electrostatic problems with the help of Gauss law and Coulomb's law.

CO2: understand the applications of scalar potential for the calculation of electric field and electric potential due to an arbitrary charge distribution.

CO3: solve the problems with the help of method of images and understand the conduction of electric current and fundamental laws of electricity and relate the electric and magnetic fields in two inertial frames of reference.

CO4: able to understand electric field, potential and polarization of different media and related quantities.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–II)
COURSE TITLE: ELECTRICITY AND MAGNETISM
COURSE CODE: FPHL-2393

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Calculus of vectors: Introduction to gradient, divergence and curl; their physical significance. Rules for vector derivatives, useful relations involving gradient, divergence and curl. Fundamental theorem for gradients, Gauss's and Stoke's theorems (statements only). Electric Field and Electric Potential: Conservation and quantization of charge. Coulomb's law.

Electric field: Electric field lines, Electric flux. Gauss's law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic field. Electrostatic potential. Potential as line integral of field, potential difference.Derivation of the field from the potential. Potential of a point and line charge distribution, uniformly charged disc, spherical shell and solid sphere. Energy associated with an electric field. Electrostatic energy of a system of charges and of a charged sphere. The Uniqueness Theorem.Differential form of Gauss's law. Laplace's and Poisson's equations.Potential and electric field of a dipole. Force and torque on a dipole.

UNIT-II

Electric Fields Around Conductors: Conductors in an electrostatic field. Equipotential Surfaces.Method of Electrical Images for finding the potential and its application to Plane Infinite Sheet.

Dielectric Properties of Matter: Dielectrics.Effect of electric field on dielectrics. Electric field due to polarisation of dielectric, Polarisationvector. Dielectricconstant, Relation between electrical Susceptibility and Dielectric constant.Capacitor (parallel-plate, spherical and cylindrical) filled with dielectric. Dipole moment of an atom. Atomic polarizability, polarizing field in Dielectric.Clausius-Mosotti formula, Gauss's law for dielectrics.Permittivity of dielectric.Energy stored in a capacitor. Electric energy density. Displacement vector D. Relation between E, P and D.

UNIT-III

Magnetic Field: Definition of Magnetic Field B.Force on a (1) point charge (2) current carrying wire in a magnetic field. Torque on a current loop in a uniform magnetic field.Biot-Savart's Law and its simple applications: straight wire and circular loop. Current loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Magnetic force between current elements.Ampere's Circuital law and its application to (i) Solenoid and (ii) Toroid. Properties of B: curl and divergence. Vector Potential. **Magnetic Properties of Matter**: Response of various substances to magnetic fields. Magnetic dipole moment of current loop, Energy of magnetic dipole in external magnetic field.Magnetic dipole moment of atom.Orbital magnetic moment of an electron.Bohr Magneton. Types of magnetic materials.Properties of diamagnetic, paramagnetic and ferromagnetic substances. Magnetisation vector (M), Magnetic Intensity(H), Magnetic Susceptibility and Permeability.Relation between B, H, M. B-H curve and hysteresis.

UNIT-IV

Electrical Circuits: AC circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR circuit.

Fields of Moving Charges: Measurement of charge in motion, Electric field in different frames of references. Electric field due to moving charge. Relation between electric fields in two inertial frames, Interaction between moving charges.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhary, 2012, Tata McGraw

2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education

3. Introduction to Electrodynamics, D.J. Griffiths, 3rdEdn., 1998, Benjamin Cummings.

4. Feynman Lectures Vol.2, R.P. Feynman, R.B Leighton, M. Sands,2008, Pearson Education

5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press

6. Electricity and Magnetism, J.H.Fewkes&J.Yarwood, Vol.I, 1991, Oxford Univ. Press

7. Electricity and Magnetism: A.K. Sikri. Pradeep Publications. 8. Electricity and Magnetism: A.S Mahajan and A.A Rangwala. Tata McGraw Hill

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: WAVES AND OSCILLATIONS

COURSE CODE: FPHL-2394

COURSE OUTCOMES

After passing this course the student will be able to:

CO1: demonstrate Lissajous figures by mechanical and analytical method with different cases.

CO2: understand fundamental description of harmonic oscillator, damped, forced and N- coupled oscillators with real examples from everyday life i.e. vibration isolation, shocker etc.

CO3: solve differential equations of forced oscillations & to obtain related quantities.

CO4: understand the concept of coupled oscillators and wave motion. Students will also be able to apply the concept of waves and oscillations to any type of waves like e. m. waves, mechanical waves.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: WAVES AND OSCILLATIONS

COURSE CODE: FPHL-2394

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A- D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 14 marks.

UNIT-I

Damped Oscillations: Superposition of two SHM by vector addition, superposition of two perpendicular SHM, Polarization, Lissajous figures–superposition of many SHMs, complex number notation and use of exponential series. Damped motion of mechanical and electrical oscillator, heavy damping, critical damping. Damped single harmonic oscillator, amplitude decay, logarithmic decrement, relaxation time, energy decay, Q value, rate of energy decay equal to work rate of damping force, problems.

UNIT-II

Forced Oscillations: Transient and steady state behaviour of a forced oscillator, Variation of displacement and velocity with frequency of driving force, frequency dependence of phase angle between force and (a) displacement, (b) velocity, Vibration Insulation – Power supplied to oscillator, Q-value as a measure of power absorption bandwidth, Q-value as amplification factor of low frequency response.

UNIT-III

Coupled Oscillations: Stiffness (or Capacitance) coupled oscillators, normal coordinates, degrees of freedom, normal modes of vibration, general method of finding normal modes, forced vibrations of two coupled oscillators, linear oscillations (two masses coupled by three springs) and their normal modes, transverse oscillations (one mass coupled with two springs, two masses coupled with three springs) and respective normal modes, N-coupled oscillators (longitudinal and vertical oscillations) and their normal modes and properties, inductance coupling of electrical oscillators, wave motion as the limit of coupled oscillations.

UNIT-IV

Wave Motion: The wave equation, transverse waves on a string, the string as a forced oscillator, characteristic impedance of a string, reflection and transmission of transverse waves at a boundary , impedance matching, insertion of quarter wave element, standing waves on a string of fixed length, normal modes and eigen frequencies. Energy in a normal mode of oscillation, wave groups, group velocity, dispersion, wave group of many components, bandwidth theorem, Doppler effect, sound waves in gases.

Reference Books:

1. The Physics of Vibrations and Waves- H.J. Pain, John Wiley, Chichester, 1999

2. Vibrations and Waves in Physics- I.G. Main-Cambridge University, Cambridge, 1993.

3. Berkeley Physics Course Vol. III (Waves)-Frank S Crawford Jr-Frank S. Crawfold Jr, 1970.

4. Vibrations and Waves, George C King, Wiley Publication 2009.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: MATHEMATICAL PHYSICS-II

COURSE CODE: FPHL-2335

Course Outcomes:

CO1: Understand the concept of Fourier series and the orthogonality of sine and cosine functions. Students will be able to expand periodic functions using Fourier series, determine Fourier coefficients for even and odd functions, and apply Parseval's identity to the summation of infinite series.

CO2: They will learn the Frobenius method for solving second-order linear differential equations with singular points. Students will understand the Legendre, Bessel, Hermite, and Laguerre differential equations along with important properties and recurrence relations of Legendre polynomials.

CO3: Learn the expansion of functions in terms of Legendre polynomials and the properties of Bessel functions of the first kind. Students will understand the generating functions, recurrence relations, zeros, and orthogonality of special functions, and apply Beta and Gamma functions in evaluating special integrals.

CO4: They will understand and solve partial differential equations using the method of separation of variables. Students will be able to solve Laplace's equation in rectangular geometry, wave equations for vibrating systems, and the 1D heat conduction equation for physical applications.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: MATHEMATICAL PHYSICS-II

COURSE CODE: FPHL-2335

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries **14 marks.**

Note: Students can use Non-Scientific calculators or logarithmic tables**.**

Unit-I

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only).Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients.Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Parseval Identity and its application to summation of infinite series.

Unit-II

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations.

Unit-III

Special Functions-2: Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x)) and Orthogonality

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions.

Unit-IV

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular geometry. Solution of wave equation for vibrational modes of a stretched string, rectangular and circular membranes. Solution of 1D heat flow equation (equation not to be derived).

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.

2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.

3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.

5. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press

6. Mathematical methods for Scientists & Engineers, D.A.McQuarrie, 2003, Viva Books

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY

COURSE CODE: FPHM-2086

COURSE OUTCOMES:

After completing this course the students will be able to

CO1: Describe VBT, VSEPR theory and predict the geometry of simple molecules & molecular orbital theory of homonuclear diatomic molecules, explain, predict & draw structures of simple ionic compounds.

CO2: To enrich the factual knowledge of chemistry related to theories of coordination complexes and calculation of C.F.S.E.

CO3: To develop an understanding of the concepts of structure and bonding of inorganic complexes and calculate microstates and spectroscopic terms.

CO4: To familiarize with p-acid ligands.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY

COURSE CODE: FPHM-2086

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. **Each question carries 8 marks.**

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT- I

Introduction, Werner's coordination theory, naming of co-ordinate complexes. Co-ordination numbers 1-12 and their stereo-chemistries. Factors affecting co-ordination number and stereochemistry. Configurational Isomers, Conformational isomerism, VSPER theory, molecular orbital theory applied to homo-nuclear diatomic molecules. Bonding in metal complexes, Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, Electro-neutrality and back bonding, limitations of V.B. theory.

UNIT- II

Stability of coordination compoundsIntroduction, Stability constant, stepwise stability constant, overall stability constant. Factors affecting the stability of metal ion complexes with general ligands, HSAB principle.Crystal field theory- Splitting of d-orbitals in octahedral, tetrahedral, cubic and square planar fields of ligands. Calculation of C.F.S.E. in high spin and low spin octahedral and High spin tetrahedral complexes, factors affecting the 10 Dq Value. Structural effects of crystal field splitting- Jahn-Teller distortion, variation of Ionic radii with increase in atomic number. Paramagnetism, diamagnetism, ferro and anti-ferromagnetism.

UNIT- III

Microstates and spectroscopic terms, a calculation of spectroscopic terms for d1 - d10 electronic configurations, L S coupling, Hund's rule for finding the ground state terms, Electronic spectral properties of Ist transition series, Orgel Diagrams for d1 - d10 systems, for weak field octahedral and tetrahedral complexes, limitations of C.F.T.

UNIT- IV

p -Acid Ligands definition Carbon monoxide complexes, bonding in linear MCO groups, polynuclear metal carbonyls, vibrational spectra, carbonyl hydrides and halides. Metal-metal bonding, metal metal multiple bonding, Structure of high nuclearity carbonyl clusters, counting of electrons in carbonyl clusters.

Text and Reference Books:

1. J.E. Huheey, Inorganic Chemistry, 3rd Ed.

2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry.

3. B.E. Douglas and D.H. McDaniel, Concepts and Models of Inorganic Chemistry

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY (LAB)

COURSE CODE: FPHM-2086

Course outcomes:

Students will be able

CO1: To develop technical skills relevant to quantitative analysis.

CO2: Will have knowledge of cations and anions.

CO3: To separate and identify the various ions present in the mixture.

CO4: To perform confirmatory tests of various ions present in the mixture.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY LAB

COURSE CODE: FPHM-2086

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one sessioN.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. Identification of cations and anions in a mixture which may contain four ions (cations and anions).

2. Perform systematic group analyses to identify the cations in the mixture. Any cation from Group I, Group II (Group IIA and IIB) Group IV, Group V and Group VI may be present.

Reference Books:

Vogel's book on Inorganic Qualitative Analysis

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (THEORY)

COURSE CODE: FPHM-2126

Course Outcomes:

CO1: Understand the basics of computer programming, including algorithms, flowcharts, program structures, and the development lifecycle. Students will be able to write and execute C programs using IDEs and command-line tools and understand C tokens, data types, symbolic constants, and preprocessor directives.

CO2: Gain the ability to use control structures like loops, conditional statements, and switch cases effectively. Students will understand storage classes, array manipulation, and string operations, including usage of library string functions.

CO3: Learn the concepts of functions and recursion in C programming. Students will be able to use pointers effectively for data handling, understand pointer operations with arrays, and apply dynamic memory allocation techniques.

CO4: Develop skills to use structures, unions, and file handling in C. Students will be able to process complex data using user-defined types and perform file operations with both text and binary files.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (THEORY)

Course Code: FPHM-2126

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters :-

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit-I

Introduction:-Introduction to Computer Programming, concept of algorithm, flow chart, program structure, Program Development life cycle - Compiling and executing programs using IDE, command line

Fundamentals: Token, Character set, Identifiers and Keywords, Constants, Variables, Expressions, Statements, Symbolic Constants; Data types, declaring variables, initializing variables, types of integers, types of floats, strings, characters C Preprocessor directives: #define Statement, Conditional Compilation, include Files typedef, enum, Type Casting

Operations and Expressions: Arithmetic operators, Unary operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Data Input and Output statements, Library functions

Unit-II

Control Statements: Preliminaries, While, Do–while and For statements, Nested loops, If–else, Switch, Break– Continue statements.

Program Structure Storage Class: Automatic, external and static variables, multiple file programs.

Arrays: Defining, processing an array, passing arrays to a function, multi–dimensional arrays,

Strings: String declaration, string functions and string manipulation.

Unit-III

Functions: Brief overview, defining, accessing functions, passing arguments to function, variable scope, specifying argument data types, function prototypes, recursion.

Pointers: Fundamentals, pointer declaration, passing pointer to a function, pointer and one-dimensional arrays, operation on pointers, pointers & multi–dimensional arrays of pointers, passing functions, dynamic memory management.

Unit-IV

Structures & Unions: Defining and processing a structure, user defined data types, structures

and pointers, passing structures to functions, self-referenced structure, unions, Arrays and Structures,

File handlingin C:- Introduction, file input/output function, binary file and text file.

References:

1. R.S. Salaria, Applications Programming in C, Khanna Book Publishing Co. (P) Ltd., Delhi.

2. Byron Gotterfied, Programming in C, Tata McGraw Hill Publishing Company Ltd., Delhi.

3. Yashvant Kanetkar, Let Us C, BPB Publications, Delhi.

4. Dennis Ritchie, Brian Kernighan, C Programming Language, Prentice Hall India

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (LAB)

COURSE CODE: FPHM-2126

Course Outcomes:

CO1: Demonstrate the ability to compile, execute, and debug C programs using an IDE, and apply C preprocessor directives and expressions in simple programs.

CO2: Implement control structures, loops, and storage classes to develop structured and efficient C programs.

CO3: Apply arrays, strings, functions, and pointers to solve problems involving modular and dynamic data handling.

CO4: Use structures, unions, and file handling techniques to manage and process complex data in C programming.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (PRACTICAL)

COURSE CODE: FPHM-2126

Credits: 3-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instructions for the examiners: -

Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab Exercises based on Implementation of C:

1. Compiling and executing programs using IDE

2. C Preprocessor directives

3. Operations & Expressions

4. Data Input and Output statements

5. Control Statements

6. Program Structure Storage Class

7. Arrays & Strings

8. Functions & Pointers

9. Structures & Unions

10. File handling in C

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: PHYSICS LAB-II

COURSE CODE: FPHP-2397

Course Outcomes:

After passing this course, students will be able to:

CO1: Students will demonstrate the ability to conduct a specific experiment from a given list, applying theoretical knowledge and practical skills to accurately complete the procedure and obtain reliable results.

CO2: Students will be able to articulate the theoretical background and principles underlying the chosen experiment.

CO3: Students will demonstrate their understanding of the experiment through oral questioning and discussion.

CO4: Students will maintain a well-organized and accurate practical file documenting all experiments conducted.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: PHYSICS LAB-II

COURSE CODE: FPHP-2397

Credits: 0-0-3 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 15 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 10 Marks

II. There will be one session of 3 hours duration. The paper will have one session and 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.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

LIST OF EXPERIMENTS

1. Use a Multimeter for measuring (a) Resistance, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a RC Circuit.
3. To compare capacitances using De Sauty's bridge.
4. Measurement of field strength and its variation in a solenoid.
5. To verify the Thevenin and Norton theorems.
6. To verify the Superposition, and Maximum power transfer theorems.
7. To determine self-inductance of a coil by Anderson's bridge.
8. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q And (d) Band width
9. To study the response curve of a parallel LCR circuit and determine its a Anti resonant frequency and (b) Quality factor Q
10. To study C.R.O as a display and measuring device by reading sine and square waves.
11. To determine the capacity of a capacitor by discharging through voltmeter.
12. To find the capacity of a capacitor using flashing and quenching of a neon lamp.
13. To determine the frequency of an electric tuning fork by Melde‟s experiment and verifyλz–T law.
14. To investigate the motion of coupled oscillators.
15. To study Lissajous Figures.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House

2. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinmann Educational Publishers

4. Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning

5. A Laboratory Manual

of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

6. Practical Physics, C.L. Arora, S. Chand & Company.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: Electromagnetic Theory
COURSE CODE: FPHL-3391

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: apply Faraday's Law and Maxwell's Equations (both differential and integral forms) to evaluate electromagnetic field behavior in time-varying and static conditions, and interpret the physical significance of displacement current and vector/scalar potentials.

CO2: demonstrate understanding of electromagnetic wave equations and their solutions in free space, dielectric, and conducting media, including the concepts of wave impedance, skin depth, and the Poynting theorem.

CO3: analyze the reflection, refraction, and transmission of electromagnetic waves at dielectric boundaries (normal and oblique incidences), apply Fresnel's equations, and understand wave propagation in plasmas and ionized gases.

CO4: describe and differentiate between linear, circular, and elliptical polarization, and evaluate the use of optical components such as Nicol prisms and wave plates for manipulating polarization in anisotropic media.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: Electromagnetic Theory
COURSE CODE: FPHL-3391

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Faraday's law & Maxwell Equations: Faraday's law of Electromagnetic Induction, a stationary circuit in time varying field, a moving conductor in a static magnetic field, a moving circuit in a time varying magnetic field. Expression for Self inductance, a circuit containing self inductance& energy stored in magnetic field, Mutual inductance and reciprocity theorem, Magnetic energy density, Ampere's law for time varying current, Concept & significance of Displacement Current, Maxwell Equations in differential & integral forms, Vector and Scalar Potentials. Gauge Transformations: Lorentz & Coulomb Gauge. Electromagnetic Boundary Conditions at Interface between two loss-less linear media and interface between a dielectric and perfect conductor.

UNIT-II

Electromagnetic Wave & Wave propagation : Wave equations & their solutions, Transverse nature of EM wave. EM wave through vacuum & isotropic dielectric medium, refractive index, dielectric constant and wave impedance. Time Harmonic Electromagnetic.Electromagnetic wave equations in conducting & non-conductiong medium. Flow of EM power: Poynting Theorem & Poynting Vector, instantaneous & average power density, Concept of relaxation time & Skin depth. Physical Concept of Electromagnetic energy density.

UNIT-III

Reflection and Refraction of waves : Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, application to propagation

through ionosphere. Normal and oblique incidence at a plane dielectric boundary: perpendicular & parallel polarization cases, Reflection & Refraction of plane waves at plane interface between two dielectric media - Laws of Reflection & Refraction, Fresnel's formulae for perpendicular & parallel polarization, Brewster's law, Reflection & Transmission coefficients in normal incidences. Total internal reflection, evanescent waves.

UNIT-IV

Polarization, production and Detection of EM Waves : Polarization of Electromagnetic Waves : Description of Linear, Circular and Elliptical Polarization. Production & detection of Plane, Circularly and Elliptically Polarized light. Uniaxial and Biaxial Crystals, light propagation in Uniaxial Crystal. Double Refraction.Polarization by Double Refraction. NicolPrism. Ordinary& extraordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates.

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
7. Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
8. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
9. Field and wave electromagnet of by David & Cheng, Addison Wesley Publication,1996.
10. Principles of optics, Max born and Emil wolf, 7th edition,1999,Pergamon press.
11. Optics, Ajoy Ghatak,2008,tata McGraw Hill.
12. Fundamental of Optics, A.Kumar, H.R.Gulati and DR Khanna,2011.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: Optics
COURSE CODE: FPHL-3392

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: explain the electromagnetic nature of light, coherence, wavefronts, and apply superposition principles to analyze interference patterns in systems like Young's double-slit, Lloyd's Mirror, Fresnel's Biprism, and thin films.

CO2: gain the ability to solve problems involving Fresnel and Fraunhofer diffraction (single slit, double slit, multiple slits, diffraction grating, and circular apertures) and apply concepts such as resolving power, Rayleigh criterion, and Bragg's law in real-world contexts.

CO3: describe the transverse nature of light and analyze polarization through reflection, refraction, and birefringent materials using Nicol prisms and wave plates. They will also evaluate optical activity and determine specific rotation using a polarimeter.

CO4: explain the principles of holography and laser operation (including types and characteristics), and analyze light transmission through optical fibers using concepts like total internal reflection and numerical aperture.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: OPTICS
COURSE CODE: FPHL-3392

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front.HuygensPrinciple.Temporal and Spatial Coherence, Superposition of N coherent waves. Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism.Principle of optical reversibility; Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Anti-reflection coatings, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

UNIT-II

Interferometer: (1)Michelson Interferometer (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes, Fabry-Perot interferometer and Echleon. Diffraction: Introduction, Fraunhoffer diffraction at a single slit, double slit and N slits, Fraunhoffer diffraction missing orders. Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating.X-ray diffraction and Bragg's law. Diffraction from a circular slit.

UNIT-III

Fresnel Diffraction:. Fresnel's Diffraction Integral and its Fraunhoffer Approximation, Fourier Optics, Fresnel's Half-Period Zones for PlaneWave, Theory of a Zone Plate: Multiple Foci of a Zone Plate.Fresnel diffraction pattern of a straight edge, a long narrow slit, circular aperture and opaque disk-Posson spot. Polarization: Transverse nature of light, Polarization by reflection and

refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, production and detection of polarized light, Optical activity, specific rotation, Half shade polarimeter.

UNIT-IV

Holography: Principle of Holography. Recording and Reconstruction Method, Theoryof Holography as Interference between two Plane Waves, Point source holograms. Lasers: Spontaneous and stimulated emission, Einstein coefficients, Main components of a laser, optical resonator, population inversion, monochromaticity of a laser beam, Helium-Neon laser, ruby and CO2 laser. Fibre optics, total internal reflection, optical fiber, numerical aperture, glass and optical fibres.

Reference Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, Pergamon Press.
3. Optics, AjoyGhatak, 2008, Tata McGraw Hill.
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
5. Optics, E. Hecht, 2008, 4th Edition, Pearson Education.
6. Schaum's Outline of Theory and Problems of Optics, E. Hecht, 1998 McGraw Hill.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)
(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: Statistics
COURSE CODE: FPHL-3393

COURSE OUTCOMES

After successful completion of this course, students will be able to:

CO1: Understand the meaning, scope, and types of data in statistics, and effectively collect, classify, and present data using tabular, diagrammatic, and graphical methods. Students will be able to apply various measures of central tendency, including Arithmetic mean, Median, Mode, Geometric mean, and Harmonic mean.

CO2: Measure and interpret the dispersion of data using range, mean deviation, quartile deviation, and standard deviation, and apply relative measures like coefficient of variation to compare variability across datasets.

CO3: Compute central and non-central moments and apply Sheppard's correction for grouped data, as well as analyze data distribution characteristics using measures of skewness and kurtosis.

CO4: Understand fundamental concepts of probability theory, including random experiments, events, sample spaces, and different probability definitions; and apply laws of probability and Bayes' Theorem in solving real-world problems.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)
(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: Statistics
COURSE CODE: FPHL-3173

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 16 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit-I

Meaning and scope of statistics, Collection of data, presentation of data, diagrammatic representation of data. Attributes and variables, discrete and continuous frequency distribution of a variable, graphical representation of frequency distribution of a variable, Arithmetic mean, median, mode, Geometric mean, Harmonic mean and their comparisons with an ideal measure of central tendency.

Unit-II

Dispersion and its measures, range, mean deviation, quartile deviation and standard deviation. Advantages of standard deviation as measure of dispersion over the other measures, Relative measures of dispersion, coefficient of variation.

Unit-III

Central and non–central moments, central–moments expressed in terms of moments about an arbitrary origin and vice-versa. Sheppard's correction for moments. Skewness and its measures, Kurtosis and its measures.

Unit-IV

Random experiments, sample space, events, mutually exclusive and exhaustive events, algebra of events, various definitions of the probability, axiomatic probability function and its properties, Finite sample spaces; equally likely outcomes, additive law of probability, conditional probability, multiplicative law of probability, independent events. Baye's Theorem and its applications.

Books Recommended:

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand and Company, 2007.
2. Croxton F.E., Cowden, D.J. and Kelin, S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon, A.M. Gupta, M.K. and Dasgupta B.: Fundamentals of Statistics, Vol. I, World Press, 2005.
4. Ross, S.A. First Course in Probability, Sixth Edition, Pearson Education, 2007.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: Introduction to Glass Science and Glass Ceramics
COURSE CODE: FPHL-3394

COURSE OUTCOMES:
After passing this course, students will be able to:

Course Outcomes:

After completing this course a student will be able to

CO1: Select appropriate raw materials for different types of glass based on their bonding nature (metallic, covalent, ionic) and amorphous/crystalline characteristics.

CO2: Utilize temperature-enthalpy relationships to design energy-efficient thermal processing protocols in glass manufacturing industries. Enables students to predict glass formation tendencies in new compositions for applications such as solar panels, optical fibers, or biomedical devices.

CO3: learn about historical developments in glasses and glass batch preparation. They will learn about physical and thermal properties of glasses..

CO4: Will learn about the commercial applications of the glasses and role of indian industries in glass technology. They will get hands-on glass preparation

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

M.Sc. (FYIP) (Physics) Semester III
Session-2025-26
Introduction to Glass Science and Glass Ceramics

Course Code: FPHL-3394

Credits: 3-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**
Instructions for the Paper Setters:
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit 1

Classification of Materials on the basis of structure: Crystalline Vs Non. Crystalline, Nature of Bonding in Materials: Metallic, ionic, covalent and mixed bonding, amorphous materials, Definition of Glass, Glasses found in nature.

Unit 2

Enthalpy/Temperature (V-T) Diagram, Glass transition and crystallization temperature, Zachariasen Structural Theories of Glass Formation, Glass-forming oxides and the concept of glass formers, modifiers, and intermediates, Nucleation and Crystal Growth.

Unit 3

Historical development of glasses, Types of glasses, Glass Preparation methods, batch calculations, Determination of Physical properties and thermal characterization, glass ceramics.

Unit 4

Applications of glass and important commercial compositions, Role of Indian industries, Challenges faced, future scope, Open Problems, Hands on training on glass preparation

Reference Books:

1. Fundamentals of Inorganic Glasses by Arun K. Varshneya and John C. Mauro
2. Introduction to Glass Science and Technology by J.E. Shelby
3. Glass Science by Robert H. Doremus

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: PYTHON PROGRAMMING
COURSE CODE: FPHM-3125

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: set up the Python development environment, write and execute basic Python scripts, use data types (int, float, complex, lists, tuples), and perform arithmetic and logical operations with appropriate input/output handling.

CO2: demonstrate the ability to manipulate strings and dictionaries, apply control statements (if-else, loops, loop control keywords), and handle user input effectively.

CO3: create and utilize user-defined and built-in functions, use lambda functions and recursion, organize code with modules and packages, and apply modular programming techniques to solve problems.

CO4: demonstrate proficiency in reading/writing text and CSV files, using file handling functions (`read()`, `write()`, `seek()`, etc.), and applying modules like `os` and `sys` for directory and system-level operations. Basic graphics handling will also be introduced.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: PYTHON PROGRAMMING
COURSE CODE: FPHM-3125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Introduction to python and Setting up the Python development Environment, Basic syntax, interactive shell, editing, saving, and running a script, Concept of data types, Declaring and using Numeric data types: int, float, complex Lists and Tuples and their basic operations, Python console Input / Output. Arithmetic operators and expressions, Conditions, Comparison operators, Logical Operators, Is and In operators.

Unit II

String Handling, Unicode strings, Strings Manipulation:- compare strings, concatenation of strings, Slicingstrings in python, converting strings to numbers and vice versa. Dictionaries Control statements: if-else, NestedIf-Else, Loops (for, while) Loop manipulation using pass, continue, break and else

Unit III

Built in function and modules in python, user defined functions, passing parameters, arguments and return values; formal vs actual arguments, Lamda function in python, Recursion, organizing python codes using functions, Programming using functions, modules and external packages

Unit IV

Files: manipulating files and directories, os and sys modules; text files: reading/writing text and numbersfrom/to a file; creating and reading a formatted file (csv or tab separated) understanding read functions, read(), readline() and readlines() Understanding write functions, write() and writelines() Manipulating filepointer using seek. Introduction to graphics.

Books Recommended:

1. Lutz, M., Learning Python, 5th edition.
2. Beazley, D., Python cookbook, 3rd Edition.
3. Beazley, D., Python Essential Reference, 4th edition.
4. Zelle, J., Python programming: An Introduction to computer science, 2nd Edition.
5. Mortelli, A., Python in a Nutshell, 2nd Edition

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–III)

COURSE TITLE: PYTHON PROGRAMMING LABORATORY

COURSE CODE: FPHM-3125

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Develop algorithms to solve basic mathematical problems including separation of odd and even numbers, summation of N natural numbers, and generation of the Fibonacci series.*

CO2: Solve algebraic equations such as quadratic and cubic equations, and evaluate mathematical functions (e.g., exp(x), log(x), sin(x), cos(x)) using Taylor series expansion.*

CO3: Perform basic data manipulation tasks such as arranging numbers in ascending/descending order, and finding maximum and minimum values from a given set of numbers.*

CO4: Apply matrix operations including calculation of determinants, inverse of a 3×3 matrix, and implement elementary numerical and statistical methods for basic data analysis.*

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–III)

COURSE TITLE: PYTHON PROGRAMMING LABORATORY

COURSE CODE: FPHM-3125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**
Examination Time: 3 Hours **Pass Mark: 12**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar
General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 15 Marks
ii) Brief Theory 5 Marks
iii) Viva–Voce 5 Marks
iv) Record (Practical file) 5 Marks
II. There will be one session of 3 hours duration. The paper will have one session and 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.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment be allotted to more than three examinee in any group.

Basic Mathematics Problems: Separation of odd and even numbers, Summation of N Natural numbers; Generating Fibonacci series, Roots of quadratic and Cubic equations; Evaluating various mathematical functions: exp(x), log(x), sin(x), cos (x) etc using Taylor series expansion; Arranging numbers in ascending and descending orders; finding maximum/minimum of numbers, for matrix operations; determinants, inverse of 3x3 matrix, elementary numerical methods and statistical methods.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: PHYSICAL CHEMISTRY
COURSE CODE: FPHM-3085

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: Understand and apply the fundamental concepts of chemical thermodynamics including system variables, laws of thermodynamics, enthalpy, heat capacity, adiabatic and isothermal processes, Joule-Thomson effect, and Carnot cycle efficiency.

CO2: Analyze thermo-chemical processes such as heats of reaction, combustion, neutralization, solution, and formation using thermochemical equations, Hess's Law, bond enthalpies, and Kirchoff's equation; apply the second and third laws of thermodynamics to calculate entropy changes and determine spontaneity of chemical processes.

CO3: Evaluate spontaneity and equilibrium in chemical systems using thermodynamic potentials (Helmholtz and Gibbs free energy), chemical potential, entropy of mixing, equilibrium constants (Kp, Kc), and apply Le Chatelier's principle and Gibbs phase rule to interpret phase diagrams.

CO4: Apply principles of chemical kinetics and electrochemistry to determine reaction rates, reaction order, activation energy, catalytic behavior, and conductance; analyze electrochemical cells, electrode potentials, EMF, and conductometric titrations for various chemical systems.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: PHYSICAL CHEMISTRY
COURSE CODE: FPHM-3085

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**
Examination Time: 3 Hours **Pass Mark: 12**

Instructions
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

UNIT-I

Chemical Thermodynamics: System and surroundings properties and variables of a system, laws of thermodynamics, Enthalpy of a system, heat capacity, Isothermal & adiabatic processes in ideal gases, Joule-Thomos effect, Carnot cycle, thermodynamic efficiency. Thermo-Chemistry: heat of reaction at constant volume and pressure thermochemical equations, calculations of E from H & vice versa, Hess's law of heat summation, heat of formation, heats of combustion, heat of solution, heat of neutralization of acids & bases, heat of formations of ions, heat of reaction from bond enthalpies, dependence of H & E for a reaction (Kirchoff's equation). II & III law of thermodynamics: Entropy, dependence of entropy on variables of a system, Entropy change in ideal gases, entropy of mixing for ideal gases, entropy change in physical transformations, Entropy change in chemical reactions, absolute Entropies, residual entropy.

UNIT-II

Spontaneity, Equilibrium and Phase Rule: General conditions for Equilibrium and Spontaneity, Helmholtz free energy (A) for reactions, Gibbs free energy.Chemical potential, Gibbs free energy and entropy of mixing of ideal gases. The Equilibrium constants Kp and Kc of real gases Temperature dependence of Equilibrium constant. The Lechatelier principle. Phase Rule: Gibbs Phase rule, derivation of phase rule, one component system, the water system, the sulphur system, two components system-simple eutectic diagram.

UNIT-III

Chemical Kinetics: Measurement of reaction rate, order, molecularity of reaction, first order reactions, second order reactions, third order reactions. Methods of determination of order, effect of temperature, activation energy, catalysis, Homogeneous catalysis in gases, homogenous catalysis insolutions, Numericals.

UNIT-IV

Electro Chemistry: Faraday's law of electrolysis, transference numbers determination of transference numbers, electrolytic conductance, variation of conductance with concentration and temperature, equivalent conductance at infinite dilution. Degree of ionization & conductance. Application of conductance measurements, Ionic product of water, hydrolysis constant, solubility & solubility product, conductometric titrations. Electrochemical Cells: Reversible & Irreversible cells, standard cells (Weston, NHE & Calomel) cell reaction & EMF, single electrode potential & its calculations, thermodynamic & EMF.

Reference Books:

1. Physical Chemistry by Samuel H, Carl P. Prutton Americ Inc. Co.
2. Physical chemistry by Glassstone, The MacmillianPressLtd.
3. Kinetics and Mechanism by frost A and Pearson R.G, Wiley Eastern Pvt. Ltd.
4. Chemical Kinetics by K.J. Laidler, Harper andRow.
5. Physical Chemistry, Gilberg W. Castellian Addison- Wesley Publishing Co.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–III)
COURSE TITLE: PHYSICAL CHEMISTRY LAB
COURSE CODE: FPHM-3085

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: Perform acid-base titrations to standardize solutions and determine properties of water samples, such as alkalinity and hardness, using appropriate volumetric techniques.

CO2: Apply principles of surface chemistry and adsorption to determine surface area and study the distribution of solutes (e.g., iodine, benzoic acid) between immiscible solvents.

CO3 Analyze physical properties of liquids such as viscosity and surface tension using viscometry and stalagmometry techniques to determine composition and molecular interactions in liquid mixtures.

CO4: Measure thermal and optical properties including heat of neutralization, refractive index, specific and molar refraction, and apply them to determine composition and thermodynamic parameters of chemical systems.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–III)

COURSE TITLE: PHYSICAL CHEMISTRY LABORATORY

COURSE CODE: FPHM-3085

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 10**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar
General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 15 Marks
ii) Brief Theory 5 Marks
iii) Viva–Voce 5 Marks
iv) Record (Practical file) 5 Marks
II. There will be one session of 3 hours duration. The paper will have one session and 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.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment be allotted to more than three examinee in any group.

1. To standardized the given solution of hydrochloric acid (HCl) and sodium hydroxide (NaOH).
2. To find out total alkalinity of given water sample (tap water).
3. To determine temporary, permanent and total hardness of given water sample (tap water).
4. To determine surface area of given solid (charcoal) by adsorption of acetic acid (CH3COOH) from aqueous solutions.
5. To determine the distribution coefficient of iodine (I2) between carbon tetrachloride (CCl4) and water (H2O).
6. To study the distribution of benzoic acid between water (H2O) and toluene and determine its molecular state of benzoic acid.
7. Determination of coefficient of viscosity of given liquid at room temperature with Ostwald's viscometer (ethyl acetate and methanol).
8. To find out the concentration of given mixture consisting of two liquids by viscosity measurements (benzene, nitrobenzene).
9. To determine viscosity of different mixture of ethanol (C2H5OH) and water (H2O) and determine composition at maximum hydrogen bonding.
10. To study variation of viscosity of aqueous sucrose solutions at various concentrations and determine the concentration of sucrose in given unknown solution.

11. To determine the % yield of oil extracted from mustard seeds with Soxhlet apparatus.
12. To determine surface tension of given liquid by drop number method using Stalagmometer at room temperature (methanol and toluene)
13. To determine percentage composition of given mixture of two liquids by surface tension measurement (benzene, nitrobenzene).
14. To determine percentage composition of given mixture of two liquids by Stalagmometer measurement (methanol and water).
15. To determine heat of neutralization of strong acid and strong base (HCl and NaOH) using Dewar flask as calorimeter.
16. To determine the refractive index of ethyl acetate and carbon tetrachloride by Abb's refractometer and find out specific and molar refraction.
17. To determine composition of unknown mixture of two liquids by refractive index measurements (ethyl acetate and carbon tetrachloride).
18. To determine % composition of unknown mixture of two liquids by surface tension measurements (water and ethanol).
19. To determine surface tension of given liquids by double capillary rise method (benzene, toluene, ethyl acetate and nitrobenzene).
20. To determine heat of neutralization of weak acid (CH3COOH) and hence calculate heat of ionization

Reference: J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publication house

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–III)

COURSE TITLE: PHYSICS LAB-III

COURSE CODE: FPHP-3396

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: verify Malus's law, determine specific rotation using a polarimeter, and analyze the polarization of light by reflection, identifying the polarizing angle at an air-glass interface.

CO2: study atomic spectra using diffraction gratings (Hg and Na lamps), measure angles of minimum deviation and prism angle, and analyze Newton's rings to determine the radius of curvature of a lens.

CO3: determine the refractive index of liquids using total internal reflection with Wollaston's air film and explore optical path variations due to interference and diffraction phenomena.

CO4: verify Stefan's law, observe electromagnetic induction in damped oscillators, study capacitor charging/discharging, and determine the electron's charge-to-mass (e/m) ratio using a solenoid.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–III)

COURSE TITLE: PHYSICS LAB-III

COURSE CODE: FPHP-3396

Credits: 3-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar
General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 30 Marks
ii) Brief Theory 15 Marks
iii) Viva–Voce 15 Marks
iv) Record (Practical file) 10 Marks
II. There will be one session of 3 hours duration. The paper will have one session and 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.
III. Number of candidates in a group for practical examination should not exceed 20.
IV. In a single group no experiment be allotted to more than three examinee in any group.

Practicals:

1. To verify the Malus law for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To study spectrum of Hg vapour lump using diffraction grating.
4. To study spectrum of Sodium vapour lump using diffraction grating.
5. To find the angle of minimum deviation & angle of prism.
6. To study Newton's fringes and determine the radius of curvature of a lens.
7. To determine the refractive index of liquid by total internal reflection using Wollaston's airfilm.
8. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
9. To verify the Stefan`s law of radiation and to determine Stefan's constant.
10. To study Electromagnetic induction in a damped oscillator.
11. Study of charging and discharging of a capacitor.
12. To determine e/m ratio of an electron using solenoid.

Reference Books:

1.Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.

2.Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3.A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal
4.Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Analog Systems & Applications
COURSE CODE: FPHL-4391

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: explain the physical properties of p-n junctions, derive expressions for barrier potential and current, and analyze diode-based circuits such as rectifiers, voltage regulators, LEDs, photodiodes, and solar cells.

CO2: evaluate transistor configurations (CB, CE, CC), determine current gains (α, β), apply load line analysis, and design biasing circuits for amplifier applications using BJT models.

CO3: analyze RC-coupled amplifier frequency response, study feedback effects, and design sinusoidal oscillators (RC phase shift, Hartley, Colpitts) using Barkhausen's criterion. They will also understand the functional characteristics of operational amplifiers.

CO4: design and analyze op-amp applications such as inverting/non-inverting amplifiers, adder/subtractor, differentiator, integrator, oscillators, and comparators. They will also understand resistive networks and A/D conversion using methods like the successive approximation technique.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Analog Systems & Applications
COURSE CODE: FPHL-4391

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram.Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea).Barrier Formation in PN Junction Diode.Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation.Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.

UNIT-II

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations.Current gains α and β Relations between α and β. Load Line analysis of Transistors.DC Load line and Q-point.Physical Mechanism of Current Flow.Active, Cutoff and Saturation Regions. Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias.Transistor as 2-port Network.h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains.Classification of Class A, B & C Amplifiers.

UNIT-III

Coupled Amplifier: RC-coupled amplifier and its frequency response. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Openloop and Closed-loop Gain.Frequency Response.CMRR. Slew Rate and concept of Virtual ground.

UNIT-IV

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation).

Reference Books:

1.Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2.Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3.Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6th Edn.,2009, PHI Learning
4.Electronic Devices & circuits, S.Salivahanan&N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5.OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6.Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7.Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8.Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Elements of Modern Physics
COURSE CODE: FPHL-4392

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: explain key quantum phenomena such as blackbody radiation, photoelectric effect, Compton scattering, and de Broglie's hypothesis. They will also analyze experiments like Davisson-Germer and double-slit interference with particles to understand wave-particle duality.

CO2: derive and interpret the Heisenberg uncertainty principle, analyze the limitations of classical trajectories, and apply the time-independent Schrödinger equation to calculate physical observables such as probability densities and energy levels for simple systems.

CO3: solve problems involving particles in potential wells (infinite box), tunneling phenomena, and apply the uncertainty principle to nuclear stability. They will understand the structure and binding energy of nuclei using liquid drop and shell models.

CO4: describe nuclear decay modes (alpha, beta, gamma), energy generation through fission and fusion, and the principles of laser operation including population inversion, metastable states, and specific laser systems like He-Ne and Ruby lasers.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Elements of Modern Physics
COURSE CODE: FPHL-4392

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT I
Planck's quantum, Planck's constant and light as a collection of photons; Balckbody Radiation; Quantum theory of Light; Photo-electric effect and Compton scattering. DeBroglic wavelength and matter waves; Davisson- Germer experiment.Wave description of particles by wave packets.Group and Phase velocities and relation between them. Two Slit experiment with electrons, photons and atoms, Probability. Wave amplitude and wave functions.

UNIT II
Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction. Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

UNIT III
One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier. Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

UNIT IV
Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions). Lasers: Einstein’s A and B coefficients. Metastable states. Spontaneous and Stimulated

emissions. Optical Pumping and Population Inversion.Three-Level and Four-Level Lasers.Ruby Laser and He- Ne Laser.

Reference Books

1.Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2.Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3.Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4.Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5.Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

Additional Books for Reference

1.Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
2.Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
3.Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
4.Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
5.Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Special Theory of Relativity
COURSE CODE: FPHL-4393

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: explain the failure of Newtonian relativity, describe key experiments (Michelson-Morley, Fizeau), derive and apply Lorentz transformations, and analyze relativistic effects such as length contraction, time dilation, simultaneity, and the Doppler effect.

CO2: apply mass-energy equivalence and relativistic momentum-energy relations, transform physical quantities between inertial frames, and interpret space-time intervals using Minkowski geometry and four-vectors.

CO3: understand the transformation of electromagnetic fields, derive and interpret Maxwell's equations in covariant four-vector and four-tensor form, and explain the electromagnetic field tensor and gauge invariance in a relativistic context.

CO4: explain the principle of equivalence, analyze gravitational redshift and Mercury's perihelion precession, and interpret Einstein's field equations using tensors and metrics, with an introduction to cosmological implications such as Hubble's law and spacetime curvature.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Special Theory of Relativity
COURSE CODE: FPHL-4393

Credits: 4 -0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I
The Lorentz Transformations: Newtonian relativity; Instances of its failure in electromagnetism; Attempts to locate the absolute frame of reference; Fizeau's experiment; Michelson-Morley experiment & Ether Drag Hypothesis; Lorentz-Fitzgerald contraction; Einstein's basic postulates of relativity and geometric derivation of Lorentz transformations; Length contraction; Relativity of simultaneity; Synchronization and time dilation; Einstein's velocity addition rule; Transformation of acceleration; Aberration (relativistic) of star light and Relativistic Doppler effect; Twin paradox and its resolution.

UNIT-II
Relativistic Dynamics: Variation of mass with velocity; Mass energy equivalence; Relativistic formulae for momentum and energy; Transformation of momentum, energy and force; Transformation of electromagnetic fields; Magnetism as a relativistic phenomenon; Illustrative examples. Structure of Space-time and Principle of Equivalence: Concept of Minkowski space; Geometrical interpretation of Lorentz transformations of space & time; Geometrical representation of simultaneity, contraction and dilation; Space-like, time like and light-like intervals; Four vectors; Concept of world lines.

UNIT-III
Relativity & Electromagnetism:- Transformation of differential operators; Invariance of D' Alembertian operator; Maxwell's equations & Gauge transformations; Equations of motion for potentials & ; Lorentz Condition; Lorentz transformations of space and time in four vector form; Transformations of charge, current density, Lorentz equations in co-variant form; Invariance of Maxwell's equations in terms four vectors; Electromagnetic field tensor; Maxwell's equations in co- variant four tensor form.

UNIT-IV
General Relativity: Principle of general co-variance; Principle of equivalence; Equality of inertial & gravitational masses; gravitational mass of photons; gravitational red shift; Precession of the perihelion of Mercury; Newton's equations of motion as an approximation of geodesic equations; Einstein's summation convention; metric tensor; Curvature tensor, G; Euclidean and Non-Euclidean geometry, Hubble's law and expansion of the universe.

Reference Books:

1. Mechanics: Berkeley Physics Course Vol-I by C. Kittel, W.D. Knight, M.A. Ruderman, C.A. Helmholtz and B.J. Moyer, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2011.
2. The Special Theory of Relativity by S. Banerji & A. Banerjee, Prentice Hall India, 2010.
3. Introduction to Special Relativity by R. Resnick, Wiley India Pvt. Ltd, 2007.
4. The Feymann Lectures on Physics: R.P. Feymann, R.B. Leighton and M. Sands, Vol. I & II, Narosa Publishing House, New Delhi, 1963.
5. Special Relativity by A.P. French, W.W. Norton and Company Inc., New York, 1968.
6. Relativistic Mechanics by Satya Prakash, Pragati Prakashan, Meerut
7. Classical Mehanics by H. Goldstein, Narosa Publishing House, Delhi, 1988.
8. Space-time Physics, J. A. Wheeler and G. N. Taylor
9. Gravitation, C.W. Misner, Kip Thorne and J. A. Wheeler, W.H. Freeman and Co., 1973
0. Introduction to The Theory of Relativity, P.G. Bergmann and Albert Einstein, Dover Books in Physics
11. Space, Time and Gravitation, A. S. Eddington, Oxford University Press

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: INTRODUCTION TO MOLECULAR SPECTROSCOPY
COURSE CODE: FPHM-4085

COURSE OUTCOMES:
After passing this course, students will be able to:

CO 1: Explain the fundamental principles of molecular spectroscopy and the interaction of electromagnetic radiation with matter.

CO2: Interpret IR and UV-Visible spectra to identify functional groups and electronic transitions in organic compounds.

CO3: Analyze 1H and 13C NMR spectra to deduce structural information about organic molecules.

CO4: Apply mass spectrometry principles to identify molecular masses, isotope patterns, and fragmentation pathways of organic compounds.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: INTRODUCTION TO MOLECULAR SPECTROSCOPY
COURSE CODE: FPHM-4085

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**
Examination Time: 3 Hours **Pass Mark: 12**

Instructions for the Paper Setters: Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

UNIT-I
Infra-red Spectroscopy: Introduction, Principles of molecular spectroscopy, electromagnetic spectrum/ radiation, Infrared spectroscopy, modes of bending and stretching, how bond strength and masses of the bonded atoms affect the IR absorption frequency, Hooke's law, Oscillator strength.FTIR, Assignment of IR frequencies to simple compounds.

UNIT-II
UV and Visible Spectroscopy: Introduction, Beer – Lambert's Law, Grotthus – Draper law, molar extinction coefficient, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra.Chromophores, auxochromes, electronic spectra of polyatomic molecules, red-shift, blue-shift, hypo and hyperchromic effect.Woodward rules for conjugated dienes and α, β- unsaturated carbonyl groups.

UNIT-III
Nuclear Magnetic Resonance Spectroscopy: Introduction to 1H NMR spectroscopy, The nuclear spin, Larmor frequency, the NMR isotopes, population ofnuclear spin levels, measurement techniques (CW andFT methods). Deuterated solvent, Nuclear shielding and 1H Chemical Shifts, range of typical chemical shifts, effects of molecular structure on 1H chemical shifts, ring currents, interpreting 1H NMR spectra, spin-spin splitting, coupling constant.13C NMR spectroscopy and chemical shifts.

UNIT-IV
Mass Spectroscopy: Introduction, Ionization methods, mass analysis, isotope abundance, Metastable ions, fragmentation patterns for aliphatic compounds, amines, aldehydes, ketones, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds, McLafferty rearrangement, general rules predicting the fragmentation patterns.
Structure elucidation of selected compounds using spectroscopic techniques discussed in sections A- D.

Reference Books:

1. John R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds. Books for additional reading: 1. F.A. Carey, Organic Chemistry.
2. C.N. Banwell “Fundamentals of Molecular Spectroscopy”.
3. W. Kemp, “Organic Spectroscopy”.
4. D. H. Williams, I. Pleming, “Spectroscopic Methods in Organic Chemistry”.
5. D. L. Pavia, G.M. Lampan and G. S. Kriz, “Introduction to Spectroscopy” HartcourtCollege Publishers, 2001.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: QUANTITATIVE ESTIMATION METHODS

COURSE CODE: FPHM-4085

CO1: Demonstrate proficiency in classical titrimetric methods for quantitative chemical analysis.
CO2: Analyze functional groups in organic compounds through appropriate analytical techniques.
CO3: Apply back-titration and complexometric titration methods for the estimation of inorganic and organic compounds
CO4: Identify and separate compounds based on their physicochemical properties using chromatographic techniques.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: QUANTITATIVE ESTIMATION METHODS

COURSE CODE: FPHM- 4085

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 10**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar
General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 15 Marks
ii) Brief Theory 5 Marks
iii) Viva–Voce 5 Marks
iv) Record (Practical file) 5 Marks
II. There will be one session of 3 hours duration. The paper will have one session and 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.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment be allotted to more than three examinee in any group.

1. Quantitative estimation of sugar (glucose) using Fehling's solution
2. Quantitative estimation of amino acid (glycine) using Sorensen formol titration
3. Quantitative estimation of hydroxyl group
4. Determination of iodide in iodised table salt by microtitration of iodine with thiosulphate (back-titration with iodine).
5. Determination of calcium by EDTA.
6. Chromatographic (TLC, Paper) identification of dyes
7. Saponification value for a dark-coloured specimen of fat

Suggested Books

1. Practical Organic Chemistry by F.G. Mann and B.C. Saunders.
2. Handbook of Property Estimation Methods for Chemicals: Environmental Health Sciences by Donald Mackay, Robert S. Boethling, (1 st Edition).
3. Systematic Lab Experiments in Organic Chemistryby S. Arun (2010).
4. Vogel's Textbook of Practical Organic Chemistry, 5 th edition.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: R PROGRAMMING
COURSE CODE:FPHM-4125

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: install and configure R and RStudio, use help functions, and work with vectors, matrices, lists, and control structures such as loops and conditionals.

CO2: demonstrate the ability to create and manipulate data frames, apply functions to data structures, use factors and tables, and write user-defined functions in R for specific computational tasks.

CO3: Students will be proficient in reading/writing data (CSV/text), using built-in math and statistical functions, performing linear algebra operations, and writing simulation programs including the use of object-oriented programming (S3/S4).

CO4: generate and customize different types of plots (bar, histogram, scatter, etc.), save visual outputs, and address performance and memory optimization issues using functional programming and debugging techniques.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: R PROGRAMMING
COURSE CODE: FPHM-4125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark:14**

Instructions:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be sub divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

UNIT-I

Downloading and installation of R and RStudio. Introducing to R, and Rstudio. Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists.

UNIT-II

Creating Data Frames – Matrix-like operations in frames, Merging Data Frames, Applying functions toData frames, Factors and Tables, factors and levels, Common functions used with factors Control statements: Loops, looping Over Nonvector Sets, if-else, writing user defined function, scope of the variable, Rscript file.

UNIT-III

Input/ Ouput: scan () , readline () Function, recursion, replacement functions, Printing to the Screen Readingand writing CSV and text file. Math functions, function for statistical distributions, linear algebra operations onvector and matrices, Basic of simulation, simulation programming in R: Built random variable generator, object –oriented programming: S3 generic functions, writing S3 and S4 Classes.

UNIT-IV

String manipulation, Graphics in R: Graph Syntax (title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions, par() command to generate multiple plots. Customizing graphs, saving graph to file, performance enhancement: speed and memory, functional programming and memory issue, Debugging.

Books Recommended:

1. Dennis, B., The R Student Companion, Taylor & Francis Group, 2013.
2. Matloff, N., The Art of R Programming: A Tour of Statistical Software Design, 2011.
3. William. L. J. P., R for Everyone: Advanced Analytics and Graphics, Addison- Wesley Data & Analytics Series. 2014.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: R PROGRAMMING LABORATORY

COURSE CODE: FPHM-4125

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Apply Taylor series expansion to compute values of mathematical functions such as exponential, logarithmic, and trigonometric functions (e.g., exp(x), log(x), sin(x), cos(x)).*

CO2: Implement basic computational techniques for data operations including sorting, searching, and determining maximum and minimum values.*

CO3: Simulate statistical experiments to estimate integrals, compute sample-based statistics such as mean, variance, and p-values from various probability distributions.*

CO4: Analyze and visualize data using graphs, perform statistical analysis including frequency distribution, correlation, and linear regression, and manage data using file handling techniques.*

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: R PROGRAMMING LABORATORY

COURSE CODE: FPHM-4125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark: 12**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and 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.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

Evaluating mathematical functions: exp(x), log(x), sin(x), cos(x), etc using Taylor series expansion; sorting, searching, maximum, minimum of numbers, Simulation: find integration, mean, variance of statistic based on a sample drawn from various distribution, p-values; graphs of functions; file handling; statistical analysis: graphical representation of data frequency distribution, correlations linear regression

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: PHYSICS LAB-IV

COURSE CODE: FPHP-4396

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Study the V-I characteristics of PN junction diodes, Zener diodes, LEDs, solar cells, and tunnel diodes, and demonstrate their practical applications in circuits such as rectifiers and voltage regulators, including calculation of efficiency and power.

CO2: Construct and test op-amp-based circuits including inverting amplifiers, integrators, differentiators, and analog simulators for differential equations, while studying gain, frequency response, and practical implementation.

CO3: Perform experiments related to blackbody radiation, photoelectric effect, and determine Planck's constant using LEDs and photo-detectors. They will also verify the tunneling effect and explore threshold frequencies.

CO4: Determine the ionization potential of mercury, e/m ratio using magnetic methods, and the elementary charge using the Millikan oil drop experiment, applying both classical and quantum principles to interpret the results.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: PHYSICS LAB-IV

COURSE CODE: FPHP-4396

Credits: 3-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar
General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 30 Marks
ii) Brief Theory 15 Marks
iii) Viva–Voce 15 Marks
iv) Record (Practical file) 10 Marks
II. There will be one session of 3 hours duration. The paper will have one session and 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.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment be allotted to more than three examinee in any group.

Practicals:
1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
5. To design inverting amplifier using Op-amp (741,351) and study its frequency response
6. To investigate the use of an op-amp as an Integrator.
7. To investigate the use of an op-amp as a Differentiator.
8. To design a circuit to simulate the solution of a 1st/2nd order differential equation.
9. Measurement of Planck's constant using black body radiation and photo-detector
10. Photo-electric effect: photocurrent versus intensity and wavelength of light and threshold frequency.
11. To determine the Planck's constant using LEDs of at least 4 different colours.
12.. To determine the ionization potential of mercury.
13. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
14. To setup the Millikan oil drop apparatus and determine the charge of an electron.
15. To show the tunneling effect in tunnel diode using I-V characteristics.

Reference Books:
1.Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2.OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.

3.Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4.Electronic Devices & circuit Theory, R.L. Boylestad& L.D. Nashelsky, 2009, Pearson
5. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
7. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)

Master of Science (FYIP) PHYSICS (SEMESTER–IV)

COURSE TITLE: MEDICAL PHYSICS

COURSE CODE: FPHP-4390

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: explain the biomechanics of body movement, stability, muscle dynamics, energy balance, and physiological systems like respiration and circulation using physical concepts such as force, pressure, and energy.

CO2: analyze sound production, hearing mechanisms, visual optics of the eye, and the nervous system's electrical functioning, including how these systems are utilized in medical diagnostics like ultrasound and EEG.

CO3: explain the production, interaction, and detection of x-rays and radiation, the principles of radiological devices (X-ray tubes, CT, MRI, PET), and the physical basis of imaging technologies and radiotherapy equipment.

CO4: demonstrate understanding of radiation units, biological effects of radiation, and principles of safe exposure, monitoring, and protection, including the use of dosimeters and shielding in therapeutic and diagnostic environments.

SKILL ENHANCEMENT COURSE

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2025-26)
Master of Science (FYIP) PHYSICS (SEMESTER–IV)
COURSE TITLE: Medical Physics
COURSE CODE: FPHL-4390

Credits: 3-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 10 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit-I

PHYSICS OF THE BODY-I
Mechanics of the body: Skeleton, forces, and body stability. Muscles and the dynamics of body movement, Physics of body crashing. Energy household of the body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Pressure system of the body: Physics of breathing, Physics of cardiovascular system.
PHYSICS OF THE BODY-II
Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. Optical system of the body: Physics of the eye. Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer.

Unit- II

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I
X-RAYS: Electromagnetic spectrum – production of x-rays, x-ray Bremsstrahlung, Characteristic x-ray, X-ray tubes: Coolidge tube (x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating), quality and intensity of x-ray. X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, high frequency generator – exposure timer, HT cables.

Unit- III

RADIATION PHYSICS: Radiation units - exposure - absorbed dose – units: rad, gray - 57 relative biological effectiveness - effective dose - inverse square law - interaction of radiation with matter - linear attenuation coefficient. Radiation Detectors -Thimble chamber- condenser chambers – Geiger

counter – Scintillation counter – ionization chamber – Dosimeters – survey methods – area monitors – TLD and semiconductor detectors.

MEDICAL IMAGING PHYSICS: X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR) – NMR imaging – MRI Radiological imaging – Radiography – Filters – grids – cassette – X-ray film – film processing – fluoroscopy – computed tomography scanner – principle function – display – generations – mammography. Ultrasound imaging – magnetic resonance imaging – thyroid uptake system – Gamma camera (Only Principle, function and display) (9 Lectures)

Unit - IV

RADIATION THERAPY PHYSICS: Radiotherapy – kilo voltage machines – deep therapy machines – Telecobalt machines – Medical linear accelerator. Basics of Teletherapy units – deep x-ray, Telecobalt units, medical linear accelerator – Radiation protection – external beam characteristics – phantom – dose maximum and build up – bolus – percentage depth dose – tissue – air ratio – back scatter factor.

RADIATION AND RADIATION PROTECTION: Principles of radiation protection – protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Personal monitoring devices – TLD film badge – pocket dosimeter. Radiation dosimetry, Natural radioactivity, Biological effects of radiation, Radiation monitors.
PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose in radiation treatment

Reference Books:

• Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)
• Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
• Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
• Physics of the human body, Irving P. Herman, Springer (2007).
• Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition (2003)
• The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
• The Physics of Radiology-H E Johns and Cunningham.