Annexure H

FACULTY OF SCIENCES

SYLLABUS

FOR

Master of Science (Physics) (FYIP)

(Semester-I & II)

(Under Credit Based Continuous Evaluation Grading System)
(CBCEGS)

Session: 2025-26

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR

(Autonomous)

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Physics) (FYIP)
Semester-I
Session- 2025-26

Master of Science (Physics) (FYIP) (Semester-I)										
Course Code	Course Title	Course Type	Hours per week L-T-P	L-T-P	Total Credits	Marks				Examination time (in Hours)
						Total	Ext.		CA	
							Th	P		
FPHL-1335	Mathematical Physics-I	C	4-0-0	4-0-0	4	100	70	-	30	3

C-Compulsory

Master of Science (Physics) (FYIP)
Semester–I
Session: 2025-26
Course Title: Mathematical Physics-I
Course Code: FPHL-1335

Course outcomes

After the completion of this course, students should be able to :

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 (Physics) (FYIP)
Semester–I
Session: 2025-26
Course Title: Mathematical Physics-I
Course Code: FPHL-1335

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 0 0 | CA: 30

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. Eulerdifferential 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.

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Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E.Harris,2013, 7th 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

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Scheme and Curriculum of Examinations of Five Years Integrated Programme
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Master of Science (Physics) (FYIP)
Semester-II
Session- 2025-26

Master of Science (Physics) (FYIP) (Semester-II)										
Course Code	Course Title	Course Type	Hours per week L-T-P	L-T-P	Total Credits	Marks				Examination time (in Hours)
						Total	Ext.		CA	
							Th	P		
FPHL-2335	Mathematical Physics-II	C	4-0-0	4-0-0	4	100	70	-	30	3

C-Compulsory

Master of Science (Physics) (FYIP)
Semester–II
Session: 2025-26
Course Title: Mathematical Physics-II
Course Code: FPHL-2335

Course outcomes

After the completion of this course, students should be able to :

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 (Physics) (FYIP)
Semester–II
Session: 2025-26
Course Title: Mathematical Physics-II
Course Code: FPHL-2335

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 0 0 | CA: 30

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 r elations.

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. Mc Quarrie, 2003, Viva Books