Course Code	Course Name	Credits
26PH009	MATHEMATICAL PHYSICS	04

Course Objectives

- To know the fundamental concepts and theorems in vector calculus, multiple integrals and differential equation
- To understand the results and effects of various concepts in differential equations, differential and integral calculus
- To apply the basic principles of differential equations, vectors calculus and multiple integrals on various physics problems
- To solve various physics problems using the mathematical tools
- To analyze and investigate various physical systems using mathematical theory

Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

- Understand and apply vector differentiation concepts including gradient, divergence, and curl with their geometrical and physical interpretations.
- Evaluate line, surface, and volume integrals and apply Stokes' and Gauss' theorems to relate different types of integrals.
- Compute double and triple integrals in various coordinate systems and apply them to find area and volume of solids.
- Formulate and solve first-order differential equations using standard methods and apply them to real-life problems like electrical circuits.
- Solve second-order differential equations and analyze physical systems such as simple harmonic motion and LCR circuits.

Unit 1 - Vectors Differential Calculus (12 Hrs.)

Vector function - Differentiation of vectors - Formulae of differentiation - Scalar and Vector point functions - Gradient of scalar function - Geometrical meaning of gradient - Normal and directional derivative -Divergence of vector function - Physical interpretation of divergence - Curl - Physical meaning of curl.

Unit 2 – Vectors Integral Calculus (12 Hrs.)

Line integral - Surface integral - Volume integral - Stoke's theorem (relation between line and surface integral) - verification- Gauss's theorem of divergence - deductions from Gauss divergence theorem.

Unit 3 - Multiple Integrals (12 Hrs.)

Double Integral: - Cartesian, cylindrical and spherical coordinate system, Evaluation - Applications: Area in cartesian and polar coordinates - volume of a solid by rotation. Triple Integrals: - Evaluation - Applications: Volume of solid bounder by sphere of cylinder and cone.

Unit 4 – First Order Differential Equation (12 Hrs.)

Introduction - Formation of differential equations - solution of a differential equation Geometrical meaning - first order differential equation - variables separable - homogenous differential equations - linear differential equations- electrical circuits - solving ODE for current - LR & CR circuits.

Unit 5 - Second Order Differential Equation (12 Hrs.)

Nonlinear differential equations - second order differential equations - homogeneous and non-homogeneous equations- fundamental theorem for homogenous differential equation - complementary function - particular integral - damped LCR circuit - simple harmonic motion.

Reference Books:

1. Dass, H. K. (2014). Mathematical Physics, (7th Revised Ed.). S. Chand.
2. Kreyszig, E. (2010). Advanced Engineering Mathematics, (9th Ed.). Wiley.
3. Griffiths, D. J. (2018). Introduction to Electrodynamics, (4th Ed.). Pearson.
4. Weber, H., & Arfken, G. (2003). Essential Mathematical Methods for Physicists, (1st Ed.). Elsevier.

Websites and eLearning Sources:

1. https://onlinecourses.nptel.ac.in/noc25_ph08/preview
2. https://youtu.be/c2IeHJOhSAg?si=QQiZRZ76cO20z6TM
3. https://youtu.be/rCw-FVegWJA?si=DYH-kT-esDnnQ4hz

COs and Bloom's Taxonomy Mapping – 26PH009		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain partial differential equations, Fourier series, and basic numerical methods.	K1, K2
CO2	Apply PDE techniques to solve wave and heat equations using separation of variables and Fourier methods.	K3
CO3	Analyze Fourier transforms and their applications in physical and signal processing problems.	K4
CO4	Evaluate numerical methods such as interpolation, integration, and curve fitting for physical systems.	K5
CO5	Develop computational solutions for differential equations and root-finding problems using numerical techniques.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH009													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	1	3	2	1	1	1	1	1.50
CO2	3	3	2	1	1	1	2	3	3	2	2	1	2.08
CO3	3	3	2	2	1	1	2	2	3	2	2	1	2.00
CO4	3	3	2	2	1	1	3	3	3	2	2	2	2.25
CO5	2	2	3	2	2	2	2	2	3	3	3	3	2.42
												Total	2.05

Mean Score: 3- High, 2- Medium/Moderate, 1-Low

FULLY HUMAN
Fully
Alive