University of Management and Technology

School of Science (SSC)

Department of Physics

Course Code: PH-307
Course Title: Mathematical Methods of Physics I
Program: BS Physics

Course Outline (Fall Semester 2024)

Lecture Schedule	**Sec. P**	**Pre-requisite**	Mechanics, Differential Equations, Linear Algebra
Course Instructor	Syed Nasrullah Ali Qazi	**Contact**	nasrullah.qazi@umt.edu.pk
Course Description	This course presents the basic mathematical techniques and ideas with its important applications commonly used to solve physical systems for various domains in Physics. The first part of the course series covers vector calculus and complex analysis with their implications in physics problems for areas such as Electromagnetism, Mechanics, Quantum Mechanics etc.		
Expected Outcomes	After successfully completing this course, the student will: • be able to understand the importance of the mathematical equations and modeling; • gain an understanding of the basic mathematical knowledge of physics of electromagnetic interactions and modeling, electromagnetic inductions, short wave limit/ long wave limit and its applications • apply the knowledge of mathematics in Physics and vice versa; • Be able to understand and discuss the rationale behind the principles and governing mathematical physics modeling. • To develop the mathematical background of student in vectors, tensors, matrices and some of their uses in the world of physics, to give basic understanding of group theory and complex variables used in physics.		
Text Book	1. Mathematical Physics by H.K Daas Seventh Edition (1997) 2. Advanced Engineering Mathematics by Dennis G. Zill, Warren S. Wright - Fifth Edition(2014)		
Reference Books	1. Mathematical Methods for Physicists (7 th Edition) by G. B. Arfken, H. J. Weber and F. E. Harris, Academic Press (2012) 2. A Guide to Mathematical Methods for Physicists by M. Petrini, G. Pradisi and A. Zaffaroni, World Scientific Press (2017) 3. Mathematical Methods in the Physical Sciences by Mary L. Boas (3rd Edition) Wiley Press(2005) 4. Mathematical Methods for Physics and Engineering by Ken Riley, Michael Hobson and Stephen Bence(3rd Edition) Cambridge Press (2005) 5. Dennery, Philippe, and André Krzywicki, Mathematics for physicists, Dover Publications (2012) 6. Mathematical methods for physics and engineering by K. F. Riley, M. P. Hobson, and S. J. Bence (3rd Edition), Cambrige (1999) 7. Mathematical Methods for Physicists: A Concise Introduction by T. L. Chow, Cambridge (2000)		
Assignments	Presentations and projects will be assigned as an assignment.	**Quizzes**	Class activities will be performed in the class related to lectures completed

			in the class. One Major quiz will be announced well before time by the department.
Mid Term Examination	A 60-minutes exam will cover all the material covered during the first half of the semester.	**Final Examination**	A 120-minutes exam will cover all the material covered during the semester.
Attendance Policy	Students missing more than 20% of the lectures will receive an "SA" grade in the course and will not be allowed to take final exam.		
Grading Policy	Assign + Quizzes + Presentation/class activity+ attendance: Mid Term Examination: Final Examination:		10+10+5+5 30 40

Learning Outcomes:

Course Learning Outcomes (CLOs)

The course is directed towards the description, analysis, investigate and applications of electromagnetic phenomena. Upon successful completion of the course, the student should be able to:

CLO	CLO Statement	PLO	Learning Domain and level	Blooms Taxonomy
1	**Remember** basic knowledge of mathematics (i.e., gradient, divergence, curl) on the mathematical equations of 1D, 2D and 3D Surfaces.	1	C1	Level 1
2	**Understand** Learn the theorems like divergence theorem, apply on physical problems like Gausses Law and divergence law to calculate integrals for sphere and circle.	2	C2	Level 2
3	**Apply** the basic time-independent and time-dependent Equation of motion for the charges in one-, two- and three-dimensional surfaces. (i.e., should be based on initial as well boundary value problems)	3	C3	Level 3

1. CLO – PLO MAPPING:

CLOs	Program Learning Outcomes (PLOs)											
	Scientific Knowledge	Problem Analysis	Conduct investigations of complex problems	Design / Development of Solutions	Science and Society	Environment and Sustainability	Ethics	Communication	Individual and Team Work	Lifelong Learning	Future Employability	Competency
	1	2	3	4	5	6	7	8	9	10	11	12
1	**C1**											
2		**C2**										
3			**C3**									

Department of Physics

PH-307 Mathematical Methods of Physics I

Lecture Plan (Fall 2024)

Week	TOPICS
1	Self-Introduction, Importance of mathematics in Physics, Laws and theories, Ladder between physics and mathematics, Some basic equations.
2	Vectors, Polar vectors, Axial Vectors, Addition of Vectors, Rectangular Resolution of Vectors, Unit Vector, Numerical 1 (finding angle b/w Vectors), Position Vector, Numerical 2 (Position Vector related), Ratio Formula, Product of Two Vectors, Scalar Product or Dot Product, Numerical 3 (Commutative property between two vectors), Geometrical Interpretation, Work done as scaler Product
3	Gradient, Divergence and Curl and Related numerical just an idea
4	Vector Product or cross product, Vector Product as a determinant, Area of Parallelogram, Moment of Force, Angular velocity, Scaler Triple product, Numerical of vector algebra
5	Vector Function, Differentiation of Vectors, Acceleration and velocity of the particle moving in curved path, Radial components of Vector, Tangential components of vector, Numerical Analysis of tangential acceleration vector, magnitude of Tangent vector, Some identical proofs
6	Gradient, Gradient of a function, One dimensional Function, two dimensional Function, Three dimensional function, Time dependent function, exponential functions, Divergence, Why divergence is important, Some equations or functions involving divergence, Numerical related to divergence, definition Curl, Momentum equation with divergence and curl term, Numerical related to above problem
7	The curl of a vector point function, numerical related to vector point function, Physical meaning of curl, Curl of the field associated with rotational properties of the field

	how?, Numerical which allow to find divergence and curl at the same time, The vector field is solenoidal How?, The vector field is irrotational How?, The vector field is rotational How?, Calculate the values of constants present in vector field, Scalar vector potential and related numerical
8	We will try to understand the vector integration in this week, Line integral, related problems to line integral, Mathematical notation for vector integrals, some important results coming from line integral (i.e., work done, Circulation effects), Open path integrations and its applications, Close integrals and its applications, Numerical to calculate work done, how to calculate the square boundary bounded by the line vectors? time variation in vector fields and work done by that
9	Greens Theorem Its applications, Greens Theorem Continuous functions with example (increasing and decreasing), Discontinuous Functions with examples (increasing and decreasing), Some important results to remember, why partial derivatives are important? in Greens Theorem, Some examples regarding Greens Theorem, Numerical
10	Stokes Theorem, difference between Greens Theorem and Stokes Theorem, Verification of Greens theorem, Conversion of line integrals to Surface integrals, Examples related to Greens Theorem and Stokes Theorem, Numerical
11	Functions of a complex variable, Cauchy-Riemann conditions
12	Multi-valued functions and branch cuts, singularities and zeroes of complex functions, complex integration, Cauchy's theorem, Cauchy's integral formula, Laurent
13	Projects
14	Presentations
15	Final

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Quiz 6	Quiz 7	Midterm Exam	Final Exam
1	✓							✓	✓
2		✓	✓		✓	✓		✓	✓
3				✓			✓	✓	✓

Faculty Signature …….

Date……

Chairman/Director signature……. Date……

Dean's signature……

Date…….