Date : 16.1.2023

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No.	:	PHY F243
Course Title	:	Methods of Mathematical Physics I
Instructor-in-charge	:	Swastik Bhattacharya
Instructor	:	Swastik Bhattacharya

Course Description :
This course deals with some of the mathematical methods which are used in many branches of theoretical physics.

Scope and Objective :
MMP I is a course on mathematical methods used in physics. The emphasis will be on understanding the general principles and on methods which have not been covered in the various core Mathematics courses which the student has already undergone. Applications cover a wide range of physical problems.

Text Books:
> T1: Mathematical Methods for Physicists: Arfken, Weber, Harris, 7th edition, Academic Press, 2012.
>
> T2: Mathematics for Physicists: Philippe Dennery, Andre Krzywicki, Dover Books on Physics, Dover Publications Inc, 1996

Reference Books:

> R1: Tensor Analysis, Schaum's outline on theory and problems of tensor calculus. Tata Mcgraw Hill.
> R2: Introduction to Vector Spaces in Physics, K.A.I.L. Wijewardena Gamalath,
> Cambridge University Press
> Notes to be provided by the instructor

Course Plan:
Sections referred to are from the text book unless stated otherwise.

Lecture No.	Learning Objectives	Topics to be Covered	Reference
1	Discussion of the objectives of the course and the approach to be followed		
2-7	Complex Analysis	Stereographic projection, Analytic functions, Cauchy's theorem, Jordan's lemma, Evaluation of	T1: Chapter 11, Notes

		integrals, gamma function	
8-12	Fourier Transform	Definition and Properties of Fourier Transform, Convolution Theorem and Applications	T1 Chapter 20, T2, Notes
13-17	Partial Differential equations	Examples of PDEs: Continuity equation, diffusion equation, Wave equation, Poisson and Laplace equation, Seperation of Variables, Boundary conditions.	T1 Chapter 9. T2
18-21	Green's functions	Motivation and Introduction to Green's Functions, Green's Identity, Adjoint Boundary conditions, 2nd order self-adjoint operators and Green's functions, properties, construction and uniqueness, Generalised Green's Functions, 2nd order ODEs with inhomogeneous boundary conditions, Sturm-Liouville problem, Eigenfunction expansion of Green's functions	T2, T1 Chapter 10
22-30	Matrices, Vector Spaces, Linear Operators.	Matrix Properties, Levi Civita symbol, Hermitian, Orthogonal Matrices, Vector spaces, Norms and Inner products, Gram Schmidt Orthogonalisation, Similarity transformations, diagonalisation	T1 Chapter 1,2,3,4 of R3
31-34	Tensors and Differential Geometry	Covariant, contravariant tensors, invariants, tensors and relativity	T1 and R2: Chapter 1,2,3,4 , Notes
35-40	Special Functions	Legendre, Bessel and Hernite polynomials, Complete basis formation using them, Transformation from one basis to another	T1, T2 and Notes

Evaluation Scheme:

EC No.	Component	Duration	Weighta ge (%)	Date & time	Nature
1	Mid Sem Exam	1.5 hrs	30	13/03 11.30 - 1.00PM	Closed Book
2	Quiz		30		Closed Book
3	Comprehensive exam	3 hours	40	08/05 AN	Open Book

Chamber Consultation Hours: To be announced in the class.

Notices: Will be displayed on the Physics department notice board and in CMS.

Make-up Policy: Make-up will be given only in genuine cases, that is, illness leading to hospitalization or going out of station with prior permission. No make-ups for the surprise tests.

Academic Honesty and Integrity Policy:
   Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
PHY F243