BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI-HYDERABAD CAMPUS

**SECOND SEMESTER 2020-21**

**COURSE HANDOUT**

*Date : 16.01.2021*

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 :**  **Subhash N Karbelkar**

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**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.

This course deals with some of the mathematical methods which are used in many branches of theoretical physics. The mathematical methods to be discussed in this course are complex variable theory, Fourier transforms, green’s functions for partial differential equations, vector spaces and tensors.

**Text Books:**

Mathematical Methods for Physicists: Arfken, Weber, Harris, 7th edition, Academic Press, 2012.

**Reference Books:**

Mathematical Methods: a modern introduction to its foundations, Sadri Hassani, Springer

**Course Plan:**

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of lectures** | **Learning Objectives** | **Topics to be Covered** | **Chapter in the Text Book** |
| 2 | Complex Analysis | Review of complex variables, Cauchy-Riemann conditions, Cauchy’s integral theorem and formula | 11.1-11.4 |
| 2 | Laurent expansions | Laurent expansion, calculus of residues | 11.5-11.7 |
| 3 | Applications of complex analysis | Evaluation of integrals, gamma function | 11.8-11.9 |
| 2 | Fourier Transform | Definition and Properties of Fourier Transform, | 20.3-20.4 |
| 5 | Fourier convolution and applications | Convolution Theorem and Applications in physics | 20.4-20.6 |
| 3 | Ordinary Differential equations | Series solutions , Frobenius method | 7.3-7.5 |
| 2 | ODEs continued | integral representations | Class notes |
| 5 | Sturm Lioville theory | Sturm Lioville theory, boundary value problems and properties of solutions | 8.1-8.5 |
| 4 | Partial Differential equations | Examples of PDEs: Continuity equation, diffusion equation, Wave equation, Poisson and Laplace equation, heat flow equation, Seperation of Variables, Boundary conditions. | 9.1-9.7 |
| 4 | Green’s functions | solutions of oneand multidimensional dimensional inhomogeneous DEs and PDEs | 10.1-10.2 |
| 4 | Vector Spaces | Gram Schmidt Orthogonalisation, operators and their transformations, invarients | Chapter 5 |
| 4 | Matrices, Linear Operators, Hermitian matrices | eigenvalue problems, Hermitian matrices and their diagonalization | Chapter 6 |
| 4 | Tensors | Covariant, contravariant tensors, invariants | Chapter 4 |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- | --- | --- |
| **EC No.** | Component | **Duration**  **minutes** | | **Weightage**  **(%)** | **Date & time** | **Nature** |
| 1 | Mid Sem Exam | 90 | 30 | | 02/03 1.30 - 3.00PM | Open book |
| 2 | 2 Tut Tests (1 before and 1 after midsem) | 30 | 30 | |  | Open book |
| 3 | Comprehensive exam | 120 | 40 | | 05/05 FN | Open book |

**Chamber Consultation Hours:** To be announced in the class.

**Notices:**  Will be displayed only on the CMS

**Make-up Policy:** Make-up will be given only in genuine cases, that is, illness leading to hospitalization.

**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**