

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**  
INSTRUCTION DIVISION  
SECOND SEMESTER 2018-2019  
Course Handout (Part-II)

*Date: 15/01/2021*

In addition to part I (General handout for all courses appended to the timetable) this portion gives further details regarding the course.

*Course Number* : **PHY F243**  
*Course Title* : **Mathematical Methods of Physics**  
*Instructor-in-Charge* : **R.R. Mishra**

**Scope & Objective of the Course:**

This course covers some special mathematical techniques used in physics. It covers vectors and tensors, linear vector spaces, complex variables and contour integration, Sturm-Liouville problem of ordinary differential equations, partial differential equations of physics.

**Text Book:**

**Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber and F.E. Harris, 7<sup>th</sup> Ed.**

**Elsevier, 2013**

**Reference Books:**

**Mathematics for Physicists, Philippe Dennerly and Andre Krzywicki, Dover Books, 1996**

**Course Plan**

Lecture No.	Learning Objectives	Topics to be Covered	Learning Outcome	Reference to Text and Reference Book
1 – 4	Review of Vector Algebra and Vector Calculus	The Del operator, Gradient, Divergence and Curl operations on scalars and vectors, Use of Kronecker Delta, Levi-Civita symbol and Einstein summation convention in proving vector identities.	To give a quick review of vector algebra and calculus.	Ch 3 (3.1 – 3.6)
5 - 12	Tensors in Cartesian and curvilinear coordinates.	Scalar, vectors and tensors under rotation of coordinate axes, Tensors in general curvilinear coordinates.	To learn transformation of tensors and tensor equations.	Ch. 4 (4.1 – 4.4)
13 – 17	Calculus of Variation.	Euler Equations, Constrained minima and maxima, More general variations.	To learn extremization of function of functions.	Ch. 22
18 – 21	Vector Spaces I	Linear vector spaces, inner product and Gram-Schmidt orthogonalization, Linear operators, Self adjoint and unitary operators, Matrix representation of operators.	To learn basic concepts of vector spaces and operators.	Ch. 5
22 – 25	Vector Spaces II	Eigenvalues and Eigenvectors of linear operators, diagonalization of matrices.	To be able to find eigenvalues and eigenvectors of matrices and diagonalize	Ch. 6

			matrices.	
26 - 31	Complex variables and contour integration	Singularities of a complex function, Calculus of residues, Evaluation of definite integrals, Branch points and branch cuts.	To be able to calculate definite integrals by using contour integration on complex plane.	Ch. 11 (11.6 – 11.8)
32 - 36	Partial differential equations.	Separation of variables method of solving Laplace, Poisson, Wave and Heat equation.	To learn the separation of variable methods for partial differential equations.	Ch. 9
37 - 40	Green Functions	Green functions in one, two and three dimensions.	To learn to solve partial differential equations by Green function technique.	Ch. 10

### **Evaluation Scheme**

<b>Evaluation Component</b>	<b>Duration</b>	<b>Weightage</b>	<b>Date &amp; Time</b>	<b>Nature of Test</b>
Mid-Semester Test	90 Minutes	30%	To be announced	Closed Book
Comprehensive Examination	3 Hours	40%	To be announced	Partly closed and partly open
Tutorial Tests (3) and Home Assignments (4)	Tutorial Tests 25 minutes each	30% (15+15)	To be announced	Closed Book Tutorial Tests

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

**Notices:** Notices and solutions will be displayed only on **PHYSICS/FDIII** notice board.

**Make-up Policy [STRICT]** No Make-ups for tutorial tests. Make up for ~~regular tests will be given only to genuine cases, i.e.~~

(i) Sickness leading to **hospitalization**, (ii) out-of-station with prior **intimation to / permission from** the IC.

*Instructor-in-Charge*  
**PHY F243**