**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

# *Hyderabad campus*

##### First Semester 2021-2022

*Course Handout* *Date: 07.09.2021*

**Course Number : PHY F431**

**Course Title : Geometrical methods of physics**

**Instructor :** Subhash Karbelkar

**Scope & Objective of the course:** The course is designed to provide students with a introduction to the geometrical methods of physics. These include tensors and differential forms on manifolds and examples from physics such as Riemannian geometry, classical and quantum mechanics, electrodynamics, gravitation and gauge theories.

**Text Book: Geometrical methods of mathematical physics, Bernard Schutz, Cambridge, 1980**

**Reference Books/E materials:**

**Gravitation by Miesner Thorne Wheeler, Freeman and Company, 1973.**

**Course Plan**:

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of lectures** | Learning Objectives | Topics to be covered | **Chapter in the Text Book** |
| 6 | Differentiable manifolds | Manifolds, vectors on manifolds, fibre bindles, one forms | 2.1 to 2.21 |
| 6 | Tensors | Tensors and tensor fields, metric tensor | 2.22 to 2.31 |
| 5 | Differential forms | Algebra and integral calculus | 4.1 to 4.13 |
| 5 | Differential forms | Differential calculus of forms and its applications | 4.14 to 4.29 |
| 5 | Application to classical mechanics | Hamiltonian mechanics | 5.4 to 5.10 |
| 5 | Applications to electrodynamics | Maxwell equations using differential forms | 5.11 to 5.14 |
| 8 | Riemannian manifolds | Covariant derivatives, metric connections, affine connection and the equivalence principle | 6.1 to 6.13 |
| 2 | Gauge theories | Connections and gauge theories | 6.14 |

**Evaluation Scheme:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***EC No.*** | ***Evaluation Component*** | *Duration* | *Weightage* ***(%)*** | ***Date, Time*** | ***Remarks*** |
| 1. | Assignment Set 1 |  | 15 |  | Open book\*\*\*  Before midsem |
| 2. | Assignement set 2 |  | 15 |  | Open Book\*\*\*  After midsem |
| 3 | Midsem | 90 Min | 35 | 18/10/2021 9.00 - 10.30AM | Open book |
| 4 | Comp. Exam | 2 Hours | 35 | 11/12 FN | Open Book |

\*\*\* : Will be assigned throughout the semester as and when a coherent topic is covered. Assigned tasks with deadline before the midsem will constitute the assignment 1 and that with later deadline will be considered as assignment 2.

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

**Notices: Will be displayed ONLY in CMS.**

**Make-up Policy:** It is applicable to the following two cases and it is permissible on production

of evidential documents.

**(i)** Debilitating illness.

**(ii)** prior permission from the IC

**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.