

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
First Semester 2015-2016
Course Handout

Date: 03/08/2015

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

Course Number : PHY F315
Course Title : THEORY OF RELATIVITY
Instructor-in-Charge : R.R. Mishra

Course Description : This is an introductory course on theory of relativity, both the special as well as the general theory.

Scope & Objective of the Course:

This course aims to expose the students to both Special and General theories of Relativity. The special theory part will comprise Lorentz transformations and some of their implications, Space-time diagrams and relativistic dynamics. The general theory part will comprise mathematical theory of curved space-time, Einstein field equations, Schwartzschild solutions and experimental tests of the general theory. A knowledge of basic mechanics is assumed.

Text Book:

T: Robert Resnick, Introduction to Special Relativity, John Wiley & Sons, 2002.

Reference Books:

R1: Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity, Steven Weinberg, John Wiley.

R2: A First Course in General Relativity, Bernard F. Schutz, Cambridge University Press.

R3: J. L. Martin, General Relativity, Prentice Hall 1996.

R4: James B. Hartle, Gravity: An Introduction to Einstein's General Relativity, Pearson.

Course Plan :

Lecture No.	Learning Objectives	Topics to be covered	Reference
1-3	Experimental background of the theory of special relativity.	Galilean Transformations, Michelson-Morley experiment, postulates of special relativity	Text Book : Sec. 1.1 – 1.10
4 – 8	Relativistic kinematics	Lorentz transformation, time dilation, length contraction, the twin paradox.	Text Book : Sec. 2.1 – 2.8
9 - 11	Geometric representation of Space-Time	Concept of 4-dimensional space-time, analysis of special theory through space-time diagrams	Text Books : Sec. A1 – A3
12 – 15	Relativistic dynamics I	Relativistic Momentum, The relativistic force law, and the dynamics of a particle, The equivalence of mass and energy	Text Book : Sec. 3.1 – 3.7
16 - 18	Relativistic dynamics II	Conservation of 4-momentum,	Class notes

		Application to relativistic scattering phenomena	
19 - 21	Curved Manifolds I	Contravariant & Covariant tensors, Tensor fields, Elementary operations with tensors	R2 : Sec. 5.1 – 5.3
22 - 24	Curved Manifold II	The affine connections, geodesics, Parallel transport and covariant differentiation	R2 : Sec. 5.4 – 5.6, Sec. 6.3 – 6.4
25 - 27	Curved Manifold III	The curvature tensor, Bianchi identities, Ricci and Einstein tensors	R2: Sec. 6.5 – 6.6
28 - 29	The principles of general relativity	The principle of equivalence, The principle of general covariance	class notes
30 - 32	The field equations of general relativity	The Einstein field equations, Weak field approximations	R2 : Sec. 8.1 – 8.4
33 - 36	The Schwarzschild solution	Schwarzschild geometry of space-time outside a spherically symmetric gravitating mass.	R2 : Sec. 10.1, 10.2, 10.4
37-40	Schwarzschild geometry and black holes, experimental tests of the general theory	Trajectories in the Swartzschild geometry, Advance of the perihelion of Mercury, Bending of light, the event horizon	R2 : Sec. 11.1 – 11.4

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Nature of Component
1	Midterm	90 mins.	30	7/10 8:00 - 9:30 AM	Closed Book
3	Tutorials/Assignments	4 Tutorial Tests, each of 20 Mins.	30	To be announced in class	Open Book/ Take home
4	Comprehensive Exam	3 hours.	40	5/12 FN	Partly open and partly closed Book

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