

Course Hand Out, PHY690M : 2023-2024, 2nd Semester

Instructor : Tapobrata Sarkar (tapo@iitk.ac.in).

Objectives : The objective of this course is to prepare the student for professional level physics skills in advanced General Relativity. The course will be useful only for those students who want to pursue research in GR and related theoretical areas in the future. The course will be highly mathematical in nature.

The prerequisite for this course is PHY407 (Special and General Relativity). Anyone who has not done PHY407 will not be accepted.

Syllabus : The syllabus is as follows :

Module 1 : Vectors, tensors, derivatives of vectors and tensors, curvature, geodesics, geodesic congruences (for both timelike and null geodesics).

Module 2 : Hypersurface, junction conditions, gravitational collapse. Lagrangian and Hamiltonian formulation of General Relativity.

Module 3 : Schwarzschild and Kerr black holes : basics properties, geodesics in these backgrounds.

There will be roughly ten lectures per module.

Books : Eric Poisson, “A relativist's toolkit : the mathematics of black hole mechanics”

Some parts of Mathias Blau's online notes will also be followed.

Attendance : You are strongly encouraged to attend all classes.

You are **very strongly** encouraged to ask as many questions as possible in class.

Evaluation : Tentatively : Mid Sem 40 marks, end sem 60 marks with uniform weightage. No quiz. Pass cut off is strictly 30 percent. There is no separate weightage for home works.

Unfair means : We follow a zero tolerance policy for unfair means and anyone found doing this in exams will be immediately de-registered from the course.

Important :

Electronic devices such as cell phones, tablets, laptops etc. are to be strictly kept in the off mode throughout the duration of all lectures unless specifically asked by the instructor.

Please note that texting/messaging or engaging in any type of social media activity during class/tutorial/exam is considered a serious offence as a matter of course policy and will attract a penalty of 10 marks per incidence.