

**Department of Earth Sciences  
Indian Institute of Technology Kanpur**

**ES655A: Solid Earth Geophysics [3-1-0-11]**

1. **Objectives:** This course will provide a comprehensive understanding of the geophysical phenomena (related to gravity, magnetic, seismology and heat flow) to visualize/understand the whole earth structure, and dynamics of the solid earth system. Students will learn the qualitative as well as quantitative aspects of plate tectonics, large scale geodynamic processes and earth's structure.
2. **Prerequisites:** None
3. **Course contents:** Total number of lecture classes = 28 (Each 75 minutes), Total number of tutorials = 13 (each one hour)

Lecture /Tutorial No.	Topics
T-1	Introduction, Scalar-vector, Index notation
1-3	Introduction to geophysics, contribution of geophysics to solid earth studies; Solar system and planet earth: Origin and evolution, Earth's internal structure;
T-2	Linear & rotational motion, Co-ordinate system, Sine-cosine laws of triangle (spherical)
4-6	Plate tectonic theory (including historical facts and hypothesis), Plate motion (Flat and spherical Earth), Triple junction, Stability analysis
T-3	Numerical problems related to plate motion and triple junction stability
7-10	Basic laws and magnetic forces (Historical review/development in magnetism), Magnetic materials, Geomagnetism, Axial and tilted dipole approximation from Laplace's Equation (spherical harmonics), Theory of geodynamo, principles of paleomagnetism, and geomagnetic reversals;
T-4	Paleo magnetic position related numerical problems
T-5	Quiz 1
11-14	Newton's law of gravity, Gravitational acceleration of rotationally distorted Earth, Tidal effects, geoid, ellipsoid, gravity anomalies, Isostasy, Elastic plate bending
T-6	Discussion on Quiz 1 paper and some numerical problems related isostasy
T-7	More numerical problems related to isostasy
15-16	Elastic waves and elastic parameters, wave equations and velocities;
T-8	Seismic waves related numerical problems
17-19	Ray theory, Snell's law, reflection and refraction, Attenuation, measuring instruments (Seismology),
T-9	Quiz 2
20-22	Introduction to earthquake seismology, intensity and magnitude scales and energy of earthquakes, foreshocks and aftershocks, Elastic rebound theory
T-10	Quiz 2 answer paper and numerical problems related to earthquake seismology
23-24	Global seismicity and tectonics, seismic phases & ray paths, internal structure of the earth as derived from seismology;
T-11	Some numerical problems related to earthquake seismology and ray path
T-12	Heat flow, conduction, convection, radiation, geotherm

25-27	Heat flow equations, Calculation of geotherms
T-13	Quiz 3
28	Discussion on Quiz 3 paper and Revision

#### 4. Lecture and Tutorial - Schedule and Venue:

(a) **Schedule and Venue:** WF10:30-11:50, Tutorial-T-17:00-18:00; WL 305

(b) **Instructor:** Animesh Mandal (Office: Old SAC building - 203, Phone: 6811, Email: animeshm@iitk.ac.in)

#### 5. Evaluation components and course policies:

(a) **Exams:** I will follow the system of Relative Grading. Final grades will be based on following weights:

Items	Marks (tentative)	Weights
Mid-Sem exam	60	30%
Quizzes (3)	60 (20×3)	15%
End-Sem exam	100	50%
Attendance to all Classes (Lectures, Tutorials, Quizzes)	100	5%

#### (b) **Policies:**

- Attendance to all classes is compulsory.
- There will be three announced quizzes (each of 20 marks).
- No make-up will be offered for quizzes, and mid-sem.

#### 6. Books and references:

Please follow the power point presentations and lecture notes from class. Time to time, additional materials in the form of chapter and papers will be given as reading material. You can also consult the following books:

- Fowler, C.M.R., 2004, The Solid Earth: An Introduction to Global Geophysics, Cambridge University Press.
- Lowrie, W., 1997, Fundamentals of Geophysics, Cambridge University Press.
- Turcotte, D.L., and Schubert, G., 2014, Geodynamics, Cambridge University Press.
- Stein, S., and Wysession, M., 2003, An Introduction to Seismology, Earthquakes, and Earth Structure, Blackwell Publishing Ltd.
- Robert J. Lillie, 1999, Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists, Prentice Hall.
- Mussett, A.E., and M.A. Khan, 1997, Looking into the Earth: An Introduction to Geological Geophysics, Cambridge University Press.