| Course Type | Course Code | Name of Course | L | T | P | Credit |
|---|---|---|---|---|---|---|
| DC | NGPC532 | Geothermics and Geodynamics | 3 | 1 | 0 | 4 |

| **Course Objective** |
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| Students will learn about the rock cycle and the water cycle, and their relationship to the flow of solar and geothermal energy. The Earth Processes: Matter Cycling and Energy Flowing. Students will learn the mutual interaction between mantle and core, crustal-mantle interaction vis-à-vis geodynamics. Geodynamics is the area of science that strives to understand the internal forces of the Earth and their effects on the crust or surface. It is a multi-disciplinary area that makes use of elements from physics, chemistry, mathematics, and more recently computer science, to generate that understanding. |
| **Learning Outcomes** |
| Understand what the geothermal gradient is. Understand that the lithosphere and asthenosphere are made from solid rock – the lithosphere is rigid and brittle but the asthenosphere can flow plastically. Be able to use the geotherm to describe why in a normal crust-mantle situation magma is not generated. Understand the quantitative aspects of plate tectonics. Understand the geomagnetic field and the principles of palaeomagnetism as they apply to plate tectonics. Practical experience of the application of elastic plate bending theory and heat conduction equations. Understand the constraints on features around the core-mantle boundary. |

| Unit No. | Topics to be Covered | Lecture Hrs. (L+T) | Learning Outcome |
|---|---|---|---|
| 1 | Evolution of the earth as a member of the solar system; distribution of major chemical elements in the inner and outer planets of the solar system,<br>Urey's hypothesis for evolution of Moon. | 3L +1T | Solar system |
| 2 | Definition of heat flow, its units and dimensions. Major sources of heat inside the Earth, role of radioactive heating, radioactive heat production, distribution of long-lived radioactive elements in crustal rocks. Various heat transport processes inside the earth. Derivations of heat conduction and advection equations. | 5L+2T | Heat source and heat flow inside the Earth |
| 3 | Thermal history of the Earth. Earth's solidification from molten magma, sinking of iron and formation of proto-core; adiabatic selfcompression. Geothermal gradient, derivation of adiabatic and melting point temperature gradients inside the earth. Stacey's model for variation of temperature and melting point with depth inside the earth. Various thermal boundaries inside the earth. | 7L +2T | Earth's thermal history |

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| 4 | Thermal structure of the oceanic lithosphere. Heat flow at subduction zones. Terrestrial heat flow for geologic processes. Pattern of continental and oceanic heat flows.<br>Measurement of continental and suboceanic heat flow. Heat flow values for continental shields and orogenic areas. | 3L+1T | Global heat flow and relevant modelling |
| 5 | Cooling of oceanic lithosphere, Thickness of oceanic lithosphere, Empirical relationships between heat flow, bathymetry and lithospheric thickness with age for oceanic areas. Mantle convection, mantle plume. Importance of Reynolds number, Nusselt number, Peclet number, and Prandtl number for convection process. | 4L+2T | Basic parameters of tectonic plates and mantle circulation |
| 6 | Heat-flow province. Geothermal provinces in India and their characteristics. | 3L + 1T | Heat flow provinces |
| 7. | Geotherms for hydrocarbon generation, Geothermal case studies for hydrocarbon bearing basins. Composition and structure of upper and lower continental crust, layering in oceanic crust. | 4L+1T | Thermal structure of hydrocarbon maturation |
| 8. | Isostasy, schemes of isostasy, reduction procedures, isostatic anomalies, study of isostatic compensation (both local and regional). Isostatic rebounds and associated vertical tectonics. Crustal structures for mountains, plateau, basins in India, Gravity and DSS studies for the Himalayas | 4L+1T | Gravitational equilibrium |
| 9 | Sea floor spreading and continental drift. Various evidences in support of the continental drift and sea floor spreading. Oceanic magnetic anomalies and their interpretations, magneto stratigraphic time scale, APWP for different continents. | 5L+ 2T | Continental drift theory and sea floor spreading and palaeomagnetism |
| 10. | Plate tectonics, plate margins and processes at plate margins, triple junction and its importance for new plate evolution. Characteristic movement of Indian plate and formation of the Himalayas. | 4L + 1T | Plate tectonics and plate margin dynamics and kinematics |
| | **TOTAL** | **42L +14T** | |

**Text Books**


1. C.M.R. Fowler, 2004. The Solid Earth: An introduction to Global Geophysics, Cambridge University Press, 728 pp.
2. D. *Turcotte*, G. Schubert, Geodynamics, 2014. Cambridge University Press, 636pp.

**Reference Books**


1. Bott, M. H. P., The Interior of the earth, Hodder & Stoughton Educational.
2. J. P. Muffler. Wiley, Chichester, 1981. Geothermal Systems: Principles and Case Histories. 359pp.
3. GSI, Geothermal Atlas of India
4. Xavier Le Pichon Jean Francheteau Jean Bonnin, 1973. Plate Tectonics, Elsevier, 314pp.
5. O. Kappelmeyer; Ralph Haenel, 1974. Geothermics with Special Reference to Applications, Geoexploration Monographs, Number 4, 238pp.