BACHLOR OF SCIENCE 5th SEMESTER
DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)
OPTION -I

GL520DA: GEOLOGY - STRUCTURAL GEOLOGY

CREDITS: THEORY-4; PRACTICAL-2
MAXIMUM MARKS: THEORY-60, PRACTICAL-30
MINIMUM MARKS: THEORY-24, PRACTICAL-12

Objective/Expected learning outcomes:
The course deals with geological structures resulting from the action of these forces on rocks. The student will gain knowledge of the geometry of the rock structures, understand the mechanism of the evolution of rock structures and its application in the field. The students learn the skills of identifying different structure and measurements using Brunton compass. This is fundamental to geological mapping. This course also helps to know how to use structures and help students appreciate the dynamic nature of the Earth lithosphere. Learn how to read geologic maps and solve simple map problems using strike and preparations of cross sections.

UNIT-1 (15 HOURS)

Basic concepts of field geology: Maps–definition, topographic and geological maps.
Dip and strike of stratified rocks, True dip, apparent dip, plunge and pitch of linear structures. Outcrop patterns. True thickness and vertical thickness. Width of the outcrop, relation between true thickness and the width of outcrop.
Criteria for distinction between normal and overturned sequences: ripple marks, cross bedding, graded bedding, mud cracks, rain-imprints, Pillow lava, vesicular tops of lava beds, Relationship of cleavage with bedding, Paleontological methods.
Mechanical principles: Stress; definition of force and stress. Normal and shear stress. Basic concept of stress ellipse. Strain definition and computation of changes in line length. Basic concept of strain ellipse.

UNIT-2 (15 HOURS)

Folds: Definition and classification (geometrical); fold parameters/components
Unconformities: Definition, types of unconformities. Criteria for recognition of unconformities.
Concordant pluton: sills, laccoliths, lopoliths, and phacoliths. Discordant pluton: dykes, volcanic vents, ring dykes.
Joints- Morphology and classification (Geometrical).
Foliation: Definition and classification; Schistosity, gneissosity, slaty cleavage
Lineation: Definition and classification, slickenside, mineral lineation Cleavage/ bedding intersections, pucker lineation, boudinage, quartz roding and mullion.

UNIT-3 (15 HOURS)

Faults: Definition, terminology and classification (geometrical)
Criteria for recognition of faults: discontinuity of structures, repetition and omission of strata, features characteristic of fault plane: slickenside, gouge, fault breccias, mylonites, silicification and mineralization, differences in sedimentary facies. Physiographic criteria: scraps, triangular facets. Offset streams.
Important concepts about Earth dynamics: outline description of Contraction, Expansion, Plate tectonic models.
Plate tectonics - basic concepts and definitions, types of plate margins, important characters of plate margins.

UNIT-4 (15 HOURS)

Mechanism of plate movement; Mantle plumes vis-à-vis island chains.
Plate tectonics in relation to the distribution of seismic, volcanic and island arc belts.
Plate tectonic models for the origin of mountain belts: Ocean-ocean, ocean-continent, Continent-Continent types of convergent boundaries
Tectonics of the Indian subcontinent: Tectonic divisions (Extra-peninsula; Indo- Gangetic Plain and Peninsular Shield), their tectonic characters and major structural trends.
Northward movement of the Indian Plate and the origin and evolution of the Himalayas and its thrust belts.
Tectonic models for the origin and evolution of the Indo-Gangetic plain. Seismicity of the Indian subcontinent

PRACTICAL (2 CREDITS: 60 HOURS)

MAXIMUM MARKS: 30, MINIMUM MARKS: 12

Study of contours and landforms; Strike, true dip and Apparent dip problems;
Measurement of thickness and width of outcrops; Completion of outcrops in geological maps; and drawing of profiles and study of geological maps.

SUGGESTED READINGS:

Ramsay, J.G. (1967) Folding and fracturing of rocks. McGraw-Hill, New York
Jain, A.K., (2014) An introduction to structural geology. Text Book series in Geological Sciences for Graduate Students. Geological Society of India, Bangalore.
Billings, M.P., (1972) Structural Geology. Prentice Hall.
Davis, G.R., (1984) Structural Geology of Rocks and Region. John Wiley.
Singh, R. P., (1995) Structural Geology: A Practical Approach. Ganga Kaveri Publ., Varanasi
Hills, E.S., (1963) Elements of Structural Geology. Farrold and Sons, London.

BACHLOR OF SCIENCE 5th SEMESTER
DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)
OPTION -II

GL520DB: GEOLOGY - CLIMATE CHANGE: PAST, PRESENT, AND FUTURE

CREDITS: THEORY-4; TUTORIAL-2
MAXIMUM MARKS: THEORY-60, TUTORIAL -30
MINIMUM MARKS: THEORY-24, TUTORIAL -12

(i) Course learning outcome:

The course introduces the students to the Earth's climate system and explores the science of global climate change using different proxies.

(ii) Broad contents of the course:

Course topics include the greenhouse effects and the science of global warming and climate change impacts.

(iii) Skills to be learned:

Students should be able to describe how the Earth's climate system works and summarize general atmosphere circulation patterns, ocean circulation patterns and climate oscillations such as the El-Niño Southern Oscillation. Besides, they will also be in a position to illustrate the Earths carbon cycle and quantitatively describe how addition of CO2 to the atmosphere due to burning of fossil fuels influences the climate.

(iv) The detail contents of this course and references and suggested books:

An interdisciplinary examination of global climate change from past, present, and future perspectives. The course will review the earth's current climate system (5), investigate evidence for past climates (5), and study climate change models (5). The factors affecting the earth's climate will be examined, along with anthropogenic impacts both globally and regionally (5). Milankovich cycle (3), Greenhouse Gases and their effect. El Niño,(5) ocean circulation(2).Climate changes vis-à-vis atmospheric hazards(5), changes in rainfall patterns/intensity vis-à-vis storm surges, cyclone, floods, droughts(5). Evolution of the Indian monsoon system (5), agro-climatic divisions of Indian subcontinent (5), Climate and landscape evolution (5). Use of climate proxies to model and motor past and present climate indicators (5).

TUTORIALS (2 CREDITS; 30 HOURS; 30 MARKS)

BASED ON THEORY COURSE

BOOKS RECOMMENDED:

- *Lowe, J.J. and Walker, M.J.C. (1997) reconstructing Quaternary Environments Longman. ISBN 0-582-100166-2. Pp. 1-16, 148-373.*
- *Bradley R. S.(1999) Paleoclimatology: Reconstructing climates of the quaternary. Academic Press v. 64 of International Geophysical series.*
- *Peixoto and Oort, (1992) Physics of Climate.*
- *Ruddiman, W. F. (2008) Earth's Climate, Past and Future, WH Freeman & Co.*
- *Bell, M. and Walker, M.J.C. (1992) Late Quaternary Environmental Change; Physical and human perspective. Longman Scientific and Technical, New York.*
- *Bradely, R.S. (1999) Paleoclimatology; reconstructing climates of the Quaternary. 2nd Edition Harcourt Academic Press: San Diego.*
- *Dawson Alastair G. Ice Age Earth: Late Quaternary Geology and Climate (Physical Environment)*
- *Bell, Martin. Late Quaternary Environmental change: Physical and Human Perspectives*
- *Rudiman, W.F., (2001) Earth's climate: past and future. Edition 2, Freeman Publisher.*
- *TERI, (2004) Looking back to change track, PHI*
- *U.B. Mathur, (2010) Climate change: Past, present and future, Geol. Soc. India.*

BACHLOR OF SCIENCE 5th SEMESTER
DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)
OPTION -III

GL520DC: GEOLOGY - OCEANOGRAPHY AND MARINE GEOLOGY

CREDITS: THEORY-4; TUTORIAL-2
MAXIMUM MARKS: THEORY-60, TUTORIAL -30
MINIMUM MARKS: THEORY-24, TUTORIAL -12

(i) Course learning outcome:
A student will understand and learn about the basic concepts of oceanography and marine geology with respect to geology as to enable them to work as a marine researcher.

(ii) Broad contents of the course:
To provide essential concepts of oceanography and to study the tectonics, geology, economic resources with respect to the oceans.

(iii) Skills to be learned:
The students will equip himself with knowledge and skills related to dealing with the physical and chemical components and phenomena related to oceanography and marine geology.

(iv) The detail contents of this course and references and suggested books:
Physical oceanography, ocean salinity, ocean currents (6), El-Nino-La Nino effect relation between climate and ocean in the Indian context (6), Exclusive economic zones and their economic potential (5), Principles behind echo sounder and side scan sonar systems (5) and seismic methods(6), Physiographic divisions of oceans(5), Origin, stricter and evolution of Indian Ocean shelf and margins (estuaries, deltas, tidal flats)(6). Approach to be interdisciplinary requiring integration of biological, chemical, physical and geological processes (6). Past historical impact of sea level changes (5), coastal erosion and conservation methods (5), Coastal Regulatory Zones (5).

TUTORIALS (2 CREDITS; 30 HOURS; 30 MARKS)

BASED ON THEORY COURSE

BOOKS RECOMMENDED:

- *Fowler, C.M.R. (1993) The Solid Earth, Cambridge Press University.*
- *Tuscot, D.L. and Schubert, G (1992) Geodynamics, Wiley and Sons.*
- *Kenneth, J. (1982) Marine Geology and Geophysics.*
- *Wright J. and Colling A. (1995) Seawater: its Composition, Properties and Behaviour, The Open University*
- *The Open University (1989) Ocean chemistry and deep sea sediments.*
- *Dronkers J. (2005) Dynamics of coastal systems, World Scientific*
- *Woodroffe, C.D. (2013) Coast: Form, process and evolution, Cambridge University Press.*
- *Nittrouer, C.A., Austin, J. A., Field M. E., Kravitz J. H., SyvitskiJ. P. M., Wiberg P.L.(2007) Continental margin, sedimentation from sediment transport to sequence stratigraphy, Wiley Blackwell.*
- *Bender, M. (2013) Paleoclimate, Princeton Premiers in Climate*
- *Bradley R. S., (1999), Paleoclimatology: Reconstructing climates of the quaternary. Academic Press v. 64 of International Geophysical series.*
- *Einsele, G. (1982) Sedimentary basins-evolution, facies and sediment budget. Springer-Verlag.*
- *Ruddiman, W.F. (2008) Earth's Climate, Past and Future, WH Freeman & Co.*

BACHLOR OF SCIENCE 5th SEMESTER
DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)
OPTION -IV

GL520DC: GEOLOGY - ISOTOPE GEOLOGY AND GEOCHEMISTRY

CREDITS: THEORY-4; TUTORIAL-2
MAXIMUM MARKS: THEORY-60, TUTORIAL -30
MINIMUM MARKS: THEORY-24, TUTORIAL -12

(i) Course learning outcome:
The course provides a forum to introduce the concept of isotopes to graduate students and the use of radiogenic and stable isotopes in geosciences.

(ii) Broad contents of the course:
Radiogenic and stable nuclides are a critical tool for dating materials, understanding planetary differentiation, and tracing provenance and process in all spheres of the earth. This course examines the theory and application of isotope geochemistry to a broad range of geologic topics.

(iii) Skills to be learned:
At the end of the course the students will be appraised about the world of isotopes amd their use in dating or geochemical tracing. 55 UGC Document on LOCF Geology

(iv)The detail contents of this course and references and suggested books:
Radiometric isotope techniques (dating and geochemical tracing) are introduced (5) through a discussion of atoms, isotopes, and radioactive decay systematic(10), followed by systematic discussion of a number of specific systems e.g., Rb-Sr, uranium-lead, etc. (15). Applications of stable isotopes to investigating volcanism (5), metamorphism (5) and meteoric-hydrothermal systems (5) are discussed. Concepts of mass-balance, mixing theory, and open and closed systems are introduced (15).

TUTORIALS (2 CREDITS; 30 HOURS; 30 MARKS)

BASED ON THEORY COURSE

BOOKS RECOMMENDED:

- *Allegre CJ, (2008) Isotope geology, Cambridge university press*
- *Dickin Alan P, (2005) Radiogenic isotope geology (2nd edition), Cambridge University Press.*
- *Faure G. and Mensing T, (2005) Isotopes: Principles and applications (3rd edition), John Willey*
- *Hoefs Jochen, (2015) Stable isotope geochemistry (7th edition), Springer*
- *Schaefer Bruce F, (2016) Radiogenic isotope geochemistry, Cambridge University Press.*
- *White William M, (2014) Isotope geochemistry, Willey-Blackwell*
- *Moore M. (1982) Principles of Geochemistry, Wiley.*