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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21 Dated: 04.10.2023

Notification

Sub:- Modification Syllabus and Scheme of Examinations Earth Science (UG) (I[st] & II[nd] Semester) with effect from the Academic year 2023-24.

Ref:- Decision of Board of Studies in Earth Science (UG) meeting held on 05.08.2023.

*****

The Board of Studies in Earth Science (UG) which met on 05.08.2023 has resolved to recommended and approved the syllabus and scheme of Examinations of Earth Science Programme (I[st] & II[nd] Semester) with effect from the Academic year 2023-24.

Pending approval of the Faculty of Science & Technology and Academic Council meetings the above said syllabus and scheme of examinations are hereby notified.

The syllabus and scheme of Examinations contents may be downloaded from the University website i.e., www.uni-mysore.ac.in.

DRAFT APPROVED BY THE REGISTRAR

04/10

Deputy Registrar (Academic)
Deputy Registrar (Academic)
University of Mysore
Mysore-570 005

To;

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS in Earth Science, Manasagangothri, Mysore.
4. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
5. The Director, PMEB, University of Mysore, Mysore.
6. Director, College Development Council , Manasagangothri, Mysore.
7. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
8. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
9. Office Copy.

B.Sc in Earth Sciences I &II Semester

<table>
<tr><th>Sem</th><th>Discipline Core (DSC)</th><th>Discipline Specific Elective (DSE)/Open Elective (OE)</th><th>Ability enhancement compulsory Courses (AECC), Languages (Credits) (L+T+P)</th><th colspan="2">Skill Enhancement Courses (SEC) (L+T+P)</th><th>Total Credits</th></tr>
<tr><td rowspan="4">I</td><td>A1- Theory
Earth System Science-Fundamentals (04 Credits)</td><td rowspan="4">OE-1
(03 credits)

Geohazards and Mitigation Strategies</td><td>L1-1 (3 credits)
04 hours each</td><td>SEC-1: Digital fluency (2) (1+0+2)</td><td rowspan="2">Health, Wellness & Yoga (2) (1+0+2)</td><td rowspan="2">25/26</td></tr>
<tr><td>A2 Practicals Maps, Sediments Soil,Field Visit (02 Credits)</td><td>L2-2 (3 credits)
04 hours each</td><td>ENV.STUDIES(3)</td></tr>
<tr><td>B1- Theory Pedology (04 credits)</td><td colspan="3" rowspan="2"></td></tr>
<tr><td>B2 - Practicals Pedology (02 Credits)</td></tr>
<tr><td rowspan="4">II</td><td>A3- Theory Basics of Crystallography & Mineralogy (04 Credits)</td><td rowspan="4">OE-2
(03 credits)

Medical Geology</td><td>L1-1 (3 credits)
04 hours each</td><td rowspan="2">ENV.STUDIES(3)/ SEC-1: : Digital fluency (2) (1+0+2)</td><td rowspan="2">Sports/NCC/NSS/R&R(S&G)/Cultural (2) (0+0+4)</td><td rowspan="2">26/25</td></tr>
<tr><td>A4 Practicals Basics of Crystallography & Mineralogy (02 Credits)</td><td>L2-2 (3 credits)
04 hours each</td></tr>
<tr><td>B3- Theory Petrology (04 credits)</td><td colspan="3" rowspan="2"></td></tr>
<tr><td>B4 - Practicals Petrology (02 Credits)</td></tr>
</table>

B.Sc in Earth Sciences I Semester

<table>
<tr><th>Sem</th><th>Discipline Core (DSC)</th><th>Discipline Specific Elective (DSE)/Open Elective (OE)</th><th>Ability enhancement compulsory Courses (AECC), Languages (Credits) (L+T+P)</th><th colspan="2">Skill Enhancement Courses (SEC) (L+T+P)</th><th>Total Credits</th></tr>
<tr><td rowspan="4">I</td><td rowspan="2">A1- Theory Earth System Science- Fundamentals (04 Credits)</td><td rowspan="4">OE-1
(03 credits)

Geohazards and Mitigation Strategies</td><td>L1-1 (3 credits)
04 hours each</td><td>SEC-1: Digital fluency (2) (1+0+2)</td><td rowspan="2">Health, Wellness & Yoga (2) (1+0+2)</td><td rowspan="2">25/26</td></tr>
<tr><td>L2-2 (3 credits)
04 hours each</td><td>ENV.STUDIES(3)</td></tr>
<tr><td>A2 Practicals Maps, Sediments Soil,Field Visit (02 Credits)</td><td colspan="4" rowspan="3"></td></tr>
<tr><td>B1- Theory Pedology (04 credits)</td></tr>
<tr><td>B2 - Practicals Pedology (02 Credits)</td></tr>
</table>

EARTH SCIENCE

EARTH SYSTEM SCIENCES (4 Credits)

(L – T – P Model)

Total Teaching Hours: 64

Teaching Hours:
4/Week. Exam.
Duration: 3 Hrs.

UNIT 1: INTRODUCTION TO EARTH SYSTEM SCIENCES 16hrs

Definition and scope of earth system sciences. Branches of Earth Sciences. Systems concepts for earth system science - fundamental concepts of the five spheres (lithosphere, hydrosphere, atmosphere, biosphere and cryosphere). Energy balance. Interactions between the five spheres; hydrologic cycle; Biogeochemical cycles - carbon cycle; Hydrosphere-atmosphere: Oceanic current system and effect of Coriolis force. Concepts of eustasy. Atmospheric circulation. Weather and climatic changes.

Interrelationships between biological, geological, climatological, and human systems on continental and global scales. Anthropogenic influences on the Earth systems; Human- environment interactions - policy.

The universe and solar system: Origin of the universe - Big bang theory. Solar system. Members of solar system – planets (Terrestrial and gaseous planets), satellite, comets, asteroids, meteorite.

Earth in the solar system. Size, shape, mass and density of the earth.

Origin of the Earth – Gaseous hypothesis, Nebular hypothesis, Planetesimal hypothesis, Tidal hypothesis, Supernova hypothesis, Interstellar or dust or meteoric hypothesis. Evolution of earth.

Age of the Earth: Geochronology; Absolute and relative methods; (a) Relative Methods - Sedimentation, Salinity method, varve chronology, Rate of cooling of earth. (a) Radiometric dating, atomic energy, decay scheme, half life, method - K-Ar; Rb-Sr; U-Pb, Pb-Pb.

Age of the earth.
Earth's internal structures and its composition. Evidence for the Earth's composition and mineralogy – 1. Seismic data, 2. Density studies, 3. Meteorites. Earth's internal layers - Crust, mantle and core. Lithosphere, asthenosphere, mesosphere and barysphere.

UNIT 2: GEOMORPHOLOGY - I

Introduction:- Basic concepts of Geomorphology, Definition and scope, Geomorphic agents, Geomorphic processes; endogenetic (epigene) and exogenetic (hypogene). Land forms. Weathering - physical, chemical, biological.

Soil - Definition, Formation, Types of soils. Soil Profile.

Rivers and fluvial landforms:- Introduction, Development of rivers - Drainage system and patterns. Stages of rivers – Davi's concept; youth, mature, old. Geologial actions: Erosion - hydraulic action, abrasion, attrition, solution. Erosional landforms – Pot holes, V shaped valleys, gorges and canyons, waterfalls and types, river meanders, ox-bow lakes, river terraces, structural benches. Transportation - suspension , solution. Deposition and depositional landforms - alluvial fans and cones, flood plains, natural levees, deltas, channel deposits.

Wind and Aeolian landforms: Types of wind – Breeze, Gale, Tempest, Cyclone. Geological action of wind: Wind erosion - Deflation, abrasion, attrition. Erosional features - mushroom rocks, yardangs, Hamda, ventifacts, pedestal rocks, zeugen, milletseed sands. Transportation- suspension, saltation, traction. Deposition and depositional landforms - Sand dunes and types, Loess.

UNIT 3. GEOMORPHOLOGY - II

Glaciers and glacial landforms. Growth and movement of glaciers. Types of glaciers – Mountain or valley glaciers, Piedmont glaciers, continental ice-sheets or ice caps. Glacier imprints. Geological action of glaciers; Erosional work by glaciers – Plucking/ Excavation, Frost wedging., Abrasion. Erosional landforms - Whaleback forms. Glacial valley - U shaped valley and V- shaped valley, Crag and Tail, Hanging valley, Cirques, Fiords, Arete, Cols, Horns, Roches Moutonnes. Transportation - glacial drift. Deposition and depositional landforms - Glacial Moraines and types, Drumlins, Kames, Eskers, Outwash plains, Kettles.

Groundwater:- Meaning and components of groundwater. Geological action of groundwater: Erosion and erosional landforms (lapis, solution holes and associated features, poljes, caves and caverns: valleys of karst topography, natural bridges). Transportation; solution. Depositional work; concretions, stalactites and stalagmites.

Oceans and Coastal landforms:- Topography of ocean floor – continental slope, shelf, abyssal zone, mid-oceanic ridges. Geological action of oceans: Agents of coastal erosion; Waves, Tides, Currents and circulation of water. Process of marine erosion, erosional landforms (Headlands and Bays, Sea Cliffs, Wave-cut Terraces, Sea caves, stacks). Transportation. Depositional landforms (Beaches and barriers, wave built terraces, Spits and bars, Tombola). Deep sea water deposits – terrigeneous and pelagic deposits. Corals - its types and origin.

UNIT 4 : GEODYNAMICS

Introduction to Geodynamics. Origin of oceans, continents and mountains. Concepts and theories of isostacy. Concept of palaeomagnetism, application of palaeomagnetism. Continental drift. Sea floor spreading. Concept of plate tectonics. Nature and types of plate margins, Midoceanic ridges and trenches. Origin and distribution of Island arcs.

Earthquakes:- definition, Elements of an earthquake, types of earthquake waves, intensity and magnitude, seismographs and seismometers, causes and prediction of earthquake, Effects of earthquake, Seismic zones of India.

Volcanoes:- A typical volcano parts, volcanic activity, types of volcanoes, composition of lava, distribution of volcanoes. Volcanic landforms; depressed landforms: Volcanic cone (Cinder Cone), Volcanic craters, Calderas (Caldera Lake). Landforms due to the accumulation of lava: Volcanic mountains, Volcanic plateaus, Volcanic plains, Volcanic necks.

References

1. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
2. Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment.Cambridge University Press.
3. Gross, M. G. (1977). Oceanography: A view of the earth.4. Brian, J. S., Barbara, W.M., 2010. The Blue Planet: An Introduction to Earth System Science,3rdEdition, Wiley.
5. Ernst, W.G., 2000. Earth Systems: Processes and Issues, Cambridge University Press.
6. Sarah, E., Cornell, I., Prentice, C., Joanna, I.H., Catherine, J.D., 2012. Understanding the Earth System Global Change Science for Application, Academic Press.
7. Jacobson, M., Charlson, R., Rodhe, H., Orians, G., 2000.Earth System Science: From Biogeochemical Cycles to Global Changes, Elsevier.
8. Ehlers, E., Krafft, T., 2006. Earth System Science in the Anthropocene, Springer.
9. *Jacobson, M. C., Charlson, R. J., Rodhe, H., and Orians, G. H., 2000, Earth System Science: San Diego, CA, Academic Press, 523 p., ISBN 0-12-379370-X*
10. The Earth System, Lee R. Kump, James F. Kasting, and Robert G Crane; Prentice Hall, 2nd Ed., 2004.
11. Principles of Geology – Arthur Holmes
12. Physical Geology – Longwell & Flient
13. General Geology – Radhakrishnan. Y

14. The Dynamic Earth – Wyllie. P.J

15. The way earth works - Wyllie. P.J

16. Physical Geology – Springfield

17. Geomorphology – Thornbury

18. Geomorphology – Davies

19. Physical Geography Today – Muller & Oberlander

I SEMESTER B.Sc. DEGREE PROGRAMMEEARTH SCIENCE

DSC/P-1: PRACTICAL-1

Total Teaching Hours: 56

LTP/Credits: /2

Teaching Hours/Week: 4

Exam. Duration: 4 Hrs.

1. Introduction to maps. Study of maps. Types of maps. Types of scale
2. Reading topographical maps of the Survey of India; Detailed study of topographic sheets
3. Preparation of topographical map
4. Identification of drainage patterns
5. Preparation of LU/LC maps.
6. Study of major geomorphic features and their relationships with outcrops through physiographic models and also using lens stereoscope and mirror stereoscope.
8. Field visit to a place of geological/geomorphological interest.

B-1 PEDOLOGY

Total Teaching Hours: 64 **LTP/Credits: 400/4**

Teaching Hours: 4/Week.

Exam. Marks Total: 100 **Exam. Duration: 3 Hrs.**

UNIT – 1

Soil pedological and edaphological concepts. Composition of earth crust and its relationship with soils; Rocks, minerals and other soil forming materials; Weathering of rocks and minerals; Factors of soil formation. Weathering sequences of minerals with special reference to Indian soils.

Morphological properties of soil profile in different landforms. Pedogenic evolution of soils; soil composition and characterization. Soil development; Pedon, polypedon, soil profile, horizons and their nomenclature. Assessment of soil profile development by mineralogical and chemical analysis.

UNIT – 2

Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts. Soil structure - genesis, types, characterization and management soil structure; soil aggregation, aggregate stability, soil conditioners. Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential.

UNIT – 3

Classification of soils using soil taxonomy: historical developments and modern systems of s oil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

Soil Erosion And Conservation: History, distribution, identification and description of soil erosion problems in India. Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and

mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity; factors affecting water erosion; soil losses in relation to soil properties and precipitation.

Soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations;soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps.

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

UNIT – 4

Soil, water and air pollution problems associated with agriculture, nature and extent. Nature and sources of pollutants - agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings. Management of problem soils: Area and distribution of problem soils - acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factorsresponsible.

Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils - soluble salts, ESP, pH; physical, chemical and microbiological properties. Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils. Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

Reclamation of salt-affected soils; mine land reclamation, afforestation, organic products. Extent, diagnosis and mapping of land degradation by conventional and modern RS-GIS tools; monitoring land degradation by fast assessment, modern tools, land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

References:

1. Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pears on Edu.

2. Biswas TD & Narayanasamy G. (Eds.) 1996. Soil Management in Relationto

   Land Degradation and Environment. Bull. Indian Society of Soil Science No. 17.

3. Boul SW, Hole ED, MacCraken RJ & Southard RJ. 1997. Soil Genesis andthe Classification. 4 Ed. Panima Publ.

4. Brewer R. 1976. Fabric and Mineral Analysis of Soils. John Wiley & Sons.

5. Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesisand Cl assification. 4th Ed. Panima Publ.

6. Dixon JB & Weed SB. 1989. Minerals in Soil Environments. 2nd Ed. SoilScienc e Society of America, Madison.

7. Doran JW & Jones AJ. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.

8. Grim RE. 1968. Clay Mineralogy. McGraw Hill.

9. Greenland DJ & Szabolcs I. 1994. Soil Resilience and Sustainable Land Use.

   CABI.

10. Gurmal Singh, Venkataramanan C, Sastry G & Joshi BP. 1990. Manual of Soil and Water Conservation Practices. Oxford & IBH.

11. Hudson N. 1995. Soil Conservation. Iowa State Univ. Press.

Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS,New

Delhi.

12. Jurinak JJ. 1978. Salt-affected Soils. Department of Soil Science & Biometeorology. Utah State Univ

13. Lal R, Kimble J, Levine E & Stewart BA. 1995. Soil Management and Greenhouse Effect. CRC Press.

14. Lal R, Blum WEH, Vailentine C & Stewart BA. 1997. Methods for Assessment of

Soil Degradation. CRC Press.

15. Middlebrooks EJ. 1979. Industrial Pollution Control. Vol. I. AgroIndustries. John Wiley Interscience. Oswal MC. 1994. Soil Physics. Oxford & IBH.

16. Ross SM. Toxic Metals in Soil Plant Systems. John Wiley & Sons.

17. Sehgal J. 2002. Introductory Pedology: Concepts and Applications. NewDelhi

18. Sehgal J. 2002. Pedology - Concepts and Applications. Kalyani.19. Sehgal J & Abrol IP. 1994. Soil Degradation in India - Status and Impact. Oxford & IBH. USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS,Washi ngton.

20. Vesilund PA & Pierce 1983. Environmental Pollution and Control. Ann Arbor

Science Publ.

21. Wade FA & Mattox RB. 1960. Elements of Crystallography andMineralogy. Oxfo rd & IBH.

22. Wilding LP & Smeck NE. 1983. Pedogenesis and Soil Taxonomy: II. TheSoil

Orders. Elsevier.

23. Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I. Concept and Interaction. Elsevier.

B-2 Pedalogy Practicals

1. Study of soil profile and determination of soil texture using ternary plot.

2. Determination of permeability of Soil based on Darcy's law.

3. Determination of Porosity of Soil.

4. Determination of Moisture content and specific gravity of soil

5. Identification and characteristics of major soil type using Karnataka and India map.

Open Elective -1

Geo hazards and Mitigation strategies

03 credits

03hrs/week

Unit-1:

Geohazards: assessment and planning- Introduction, types of hazards; characteristic features, occurrence and impact of different types, Causes and Strategies for Mitigation of Geological Hazards; Risk assessment, Hazard maps, Land-use planning and hazards.

Unit-2:

Earthquakes, Mitigation Approaches: – Earthquake, its Causes, Specific threats, Community impacts, and Mitigation strategies. Characteristic features; Earthquake Risk Mitigation Magnitude and Intensity of earthquake; Major earthquakes; Seismic zoning; Earthquake vulnerability of India; Earthquake risk mitigation – Seismic performance examination of RCC Buildings, retrofitting of vulnerable buildings, Construction of earthquake resistant buildings following proper BIS codes, Earthquake preparedness; Case study – 'Bhuj Earthquake'. Volcanic hazard: Introduction, Types of volcanoes, Volcanic form and structure, Types of central eruption, Causes of volcanic eruptions, Volcanic products: volatiles, Volcanic products: pyroclasts, Volcanic products: lava flows, Specific threats, Community impacts, Volcanic hazard and prediction Mitigation strategies.

Unit-3:

Tsunami Events, Mitigation Approaches: An introduction to Tsunami; Magnitude & Intensity of a Tsunami; Types of Tsunami; Features of Tsunamis; Prediction of Tsunamis; Tsunami Hazard Mitigation.

Flood and Mitigation Approaches: Types of floods**,** Causes of floods**,** Specific threats**,** Community impacts**.** Mitigation strategies**:** Floodplain Management**,** Flood Insurance**,** Flood Mitigation Programs**,** Property Acquisitions**,** Retrofitting Flood Prone Residential Structures.

Mass movements: Soil creep and valley bulging, Causes of landslides, Classification of landslides, Landslides in soils Landslides in rock masses, A brief note on slope stability analysis. Monitoring slopes, Landslide hazard, investigation and mapping, Methods of slope control and stabilization Landslide Specific threats, Community impacts, Mitigation strategies.

References:

1. Alexander, D. (1993) Natural Disasters. University College LondonPress, London.

2. Alden, W. C., 1928. Landslide and Flood at Gros Ventre, Wyoming, Focus on Environmental Geology, Tank R., Ed., Oxford University Press, New York (1973), 1928, pp. 146–153.

3. Baker, P.E. (1979) Geological aspects of volcano prediction. Journal of Geological Society, 136, 341-346.

4. Bell, F.G., (1999). Geological hazards: their assessment, avoidance, and mitigation. (an imprint of Routledge). E&FN Spon, London, UK, Hardbound, ISBN 0-419-16970-9;631 Pages.

5. Bell, F.G. (1994) Floods and landslides in Natal and notably the greater Durban region, September 1987: a retrospective view. Bulletin Association Engineering Geologists, 31, 59-74.

6. Broms, B. B., Landslides , Foundation Engineering Handbook , Winterkorn, H. F. and Fang, H.-Y., eds., Van Nostrand Reinhold Co.,

7. Bernard, E.N. (Ed.), Developing Tsunami-Resilient Communities: The National Tsunami Hazard Mitigation Program, Reprinted from Natural Hazards, 35:1 (2005) 2005, VI, 186 p., ISBN: 978-1-4020-3353-7.

8. Bollinger, G. A., 1976. The seismic regime in a minor earthquake zone,Proc. ASCE Numer. Methods Geomech., 2, 917–937.

9. Bullard, R.M. (1976) Volcanoes of the Earth. University of Texas Press, Austin.

10. Bolt, B.A. (1978) Earthquakes: A Primer, W.H.Freeman, San Francisco.

11.Bolt, B.A. (1993) Earthquakes. W. H. Freeman, New York.

12. Forgione, G., Luongo, G. and Romano, R. (1989) Mt Etna (Sicily): Volcanic hazard assessment. In Volcanic Hazards: Assessment and Monitoring, Latter, J.H. (ed.), Springer-Verlag, Berlin, 137-150.

13. Hamilton, R. M., 1978. Earthquake Hazards Reduction Program-Fiscal Year 1978 Studies Supported by the U.S. Geological Survey, Geological Survey Circular 780, U.S. Dept of the Interior.

14. Leeds, D. J., 1973. The Design Earthquake, in Geology, Seismicity and Environmental Impact, Special Publication Association of Engineering Geology, Los Angeles, CA.

15. Ramesh P. Singh & Darius Bartlett, 2018. Natural Hazards: Earthquakes, Volcanoes, and Landslides.527 Pages.

16. Sassa, K., Fukuoka, H., Yang, Q.J., and Wang, F.W., 1997. Landslide Hazard Assessment in Cultural Heritage, Lishan, Xian, Proceedings International Symposium on Landslide Hazard Assessment, 1–24, Xian, China.

17. Seed, H. B., 1966. A method for earthquake resistant design of earth dams, Proc. ASCE J. Soil Mech. Found. Engrg. Div., 92, 13–41.

18. Thenhaus, P. C. and Campbell, K. W.,2003. Seismic hazard analysis, in Earthquake Engineering Handbook, Chen, W. and Scawthorn, C., Eds., CRC Press, Boca Raton, FL

B.Sc in Earth Sciences II Semester

<table>
<tr><th>Sem</th><th>Discipline Core (DSC)</th><th>Discipline Specific Elective (DSE)/Open Elective (OE)</th><th>Ability enhancement compulsory Courses (AECC), Languages (Credits) (L+T+P)</th><th colspan="2">Skill Enhancement Courses (SEC) (L+T+P)</th><th>Total Credits</th></tr>
<tr><td rowspan="5">II</td><td>A3- Theory Basics of Crystallography & Mineralogy (04 Credits)</td><td rowspan="5">OE-2
(03 credits)

Medical Geology</td><td>L1-1 (3 credits)
04 hours each</td><td rowspan="2">ENV.STUDIES(3)/ SEC-1: : Digital fluency (2) (1+0+2)</td><td rowspan="2">Sports/NCC /NSS/R&R(S&G)/Cultural (2) (0+0+4)</td><td rowspan="2">26/25</td></tr>
<tr><td>L2-2 (3 credits)
04 hours each</td></tr>
<tr><td>A4 Practicals Basics of Crystallography & Mineralogy (02 Credits)</td><td colspan="3" rowspan="3"></td></tr>
<tr><td>B3- Theory Petrology (04 credits)</td></tr>
<tr><td>B4 - Practicals Petrology (02 Credits)</td></tr>
</table>

A3- Theory

Basics of Crystallography & Mineralogy (04 Credits)

Unit 1: Introduction, definition and scope of crystallography, definition of a crystal, formation of crystals: crystalline and amorphous substance, crystal elements: interfacial angle, contact goniameter.

Crystallographic axes: axial characters of geometric constants; axial ratio; classification of crystals into systems based on geometrical constants- Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic systems.
Symmetry in crystals, definition, elements of symmetry-centre, plane, axis and roto-inversion axis of symmetry, symmetry notation- Weiss notation, Hermann Mauguin symbols and Millers indices, law of rational indices, grade of symmetry.

Twins: definition, parts of a twin, types of twins, twin laws

Unit 2: Introduction: definition of mineral, history of mineralogy, branches of mineralogy.

Physical mineralogy: characters depending upon the state of aggregation- habit, form.
Characters depending upon cohesion and elasticity: cleavage, fracture, hardness, tenacity.
Characters depending upon light: color, streak, luster, diaphaneity.
Characters depending upon the state of aggregation: habit, form.
Characters depending upon light: colour, streak, luster, diaphaneity, iridescence, Opalescence, Luminescence, Fluorescence, phosphorescence tarnish.
Characters depending upon electricity (conductivity: pyro, piezo) and magnetism:(para and dia). Specific gravity and methods of determining specific gravity – Walker's steel yard.

Unit 3: Chemical Mineralogy: Bonding of molecules – Ionic, Covalent, Metallic, Vander Walls. Isomorphism and Polymorphism.
Classification of minerals based on chemical composition. Oxides and Carbonates. Silicates: abundance in the crust, classification of silicates, based on structures – Neso, Soro, Cyclo, Ino, Phyllo, Tectosilicates.

Study of groups of minerals: quartz group, feldspar group, garnet group, mica group, pyroxene and amphibole groups

Unit -4 : OPTICAL MINERALOGY-Nature of light, Nomenclature of wave theory, reflection and refraction of light, Refractive index, Critical angle, Total reflection. Principles of optical mineralogy. Introduction to petrological microscope. Theory of light propagation in Isotropic, uniaxial and biaxial crystals. Interference color, classification of interference color Michael Levy's chart Optical accessories: Mica plate, gypsum plate and quartz wedge and its effects on a mineral section between crossed nicols Pleochroism:- dichroism, trichroism.

Extinction, types of extinction straight, inclined, undulose and symmetrical extinction

References:

1. Mineralogy, Crystallography & Crystal Chemistry – Bloss.D
2. Textbook of Mineralogy – Dana
3. Rock Forming Minerals – Deer, Howie &Zussman
4. Mineralogy – Shrock
5. Manual of Mineralogy – Klien, C & Hurlburt, C.S.Jr.
6. The 23rd Edition of the Manualof Mineral science (after James D.Dana) Klien, C., Dutrow,B., Dwight,J and Klien, C-J. Wiley and Sons
7. Introduction to Mineral Sciences. Putnis.A- Cambridge University Press
8. An introduction to crystallography- Burger
9. Elementary crystallography- Burger
10. Crystal chemistry – Kutty T.R.N and Tareen J.A.K
11. Elements of x-ray crystallography-Axaroff
12. An Introduction to crystal chemistry- Evans .R.C
13. Elemental crystallography- Tareen J.A.K and Kutty T.R.N

A4. Crystallography & Mineralogy practicals 02-Credits

Total Teaching Hours: 56

1. Study of crystals based of geometrical constants.

2. Measurement of interfacial angle using contact goniometer and Verification of Euler's theorem

3. Study of holohedral forms of six crystal system.

4. Study of Physical properties of rock forming minerals

5. Study of the optical properties of important rock forming minerals using polarizing microscope: Quartz, Plagioclase, Orthoclase, Microcline, Biotite, Hornblende, Augite, Hypersthene, Olivine, Garnet, Calcite.

6. Visit to field to study the mode of occurrence of minerals.

B3- Petrology Theory

64 hours(04 hrs/Week) **04 Credits**

Unit 1 - Introduction: Definition of a rock. Classification of rocks - Igneous, Sedimentary & Metamorphic rocks. Rock cycle.
Magma: Definition, types and composition.The Process of Magma Rise and Emplacement: Diapir, Room Problem, Stoping, Liquid Immiscibility, Assimilation and Fractional Crystallization, Mixing of Magmas. Crystallization behavior of natural magmas: Bowen's Reaction Principle.
Igneous petrology: Introduction to Igneous petrology. Classification and Nomenclature of Igneous Rocks: Classification of igneous rocks based on grain size – Phaneritic, Aphanitic, Fragmental. Phaneritic rocks classification – fine, medium, coarse and very coarse grained. Classification based on composition – acidic, intermediate, basic & ultrabasic. Classification based on colour Index – Leucocratic, Mesocratic, Melanocratic &Hypermelanic. Classification based on depth – plutonic, hypabyssal and volcanic. Tabular classification of Tyrrell.
Forms of igneous rocks- extrusive and intrusive: Concordant - sill, laccolith and phacolith. Discordant - dyke, ring dyke, cone sheets, volcanic neck, stock, boss and batholiths **Systems** : One-Component Systems, Two-Component (Binary) Systems – A) Binary Systems with Complete Solid Solution B) Binary Eutectic Systems
Igneous rock Structures & Textures: Structures: Amygdaloidal, Blocky, Ropy, Pillow and Columnar.
Textures: Texture – Definition**.** Crystallinity (Holocrystalline, Hypocrystalline and Holohyaline), granularity (Aphanitic , Phaneritic and Cryptocrystalline), Form of Individual Grains (Euhedral, Subhedral and Anhedra) and mutual relationship of crystals. Kinds of textures: Equigranular - Panidiomorphic, hypidiomorphic and allotriomorphic; Inequigranular - Porphyritic, poikilitic, ophitic, basaltic, intergrowth and flow textures.
Igneous Rock Associations: An introduction on Igneous rocks of oceanic regions, Igneous rocks associated with convergent plate boundaries, Continental flood basalts and large igneous provinces, Large layered igneous complexes, Continental alkaline rocks, Ultra-alkaline and silica-poor alkaline rocks, Special Precambrian associations, Meteorite-impact-generated

Unit2 : Introduction to sedimentary petrology, weathering and the sedimentary cycle, applications of sedimentology.
Transportation and Sedimentation: 1. Aqueous processes: Sedimentation from traction currents 2. Eolian processes: Sedimentation from traction and suspension. 3. Glacial processes and 4. Gravitational processes.
Sedimentary basins: Generating processes – crustal sag, tension, compression and wrenching.
Sedimentary Structures: Primary and Secondary structures. Primary structures – A) Organic: Burrows and trails B) Inorganic: Classification of inorganic structures i] pre-depositional – channels, Scour and fill, flute and groove marks ii] syn-depositional – flat bedding, graded bedding, cross bedding and lamination iii] post-depositional – slump, slide, convolute lamination and bedding, recumbent foresets and load structures iv] Miscellaneous – rain prints and shrinkage cracks. Environmental interpretation of sedimentary structures.
Depositional systems: I. Sedimentary Environments; Definition of sedimentary environment, classification of environments of deposition - Terrestrial, Lacustrine, Delta; onshore and offshore, Beach, Tidal flat area; salt marsh, tidal flat and channel, Continental slope and shelf. II. Sedimentary Facies – definition.
Genetic classes of sediment – chemical, organic, residual, terrigenous and pyroclastics. Classification of Sedimentary Rocks with examples: I. Allochthonous sediments – Terrigenous and pyroclastic deposits and II. Autochthonous sediments - chemical, organic, residual deposits. Classification of terrigenous rocks based on particle size –Rudaceous, Arenaceous and Argillaceous.

Unit3: Introduction: Metamorphism – definition;Metamorphic agents - Temperature, pressure, fluids and time. Geothermal gradient.

Types of metamorphism: (A) Contact Metamorphism – Pyrometamorphism (B) Regional Metamorphism - Orogenic Metamorphism, Regional contact metamorphism, Burial Metamorphism, Ocean Floor Metamorphism, (C) Hydrothermal Metamorphism (D) Fault-Zone Metamorphism (E) Impact or Shock Metamorphism (F) Pneumatolytic Metamorphism. Progressive nature of metamorphism: Prograde and regtrograde.

A Classification of metamorphic rocks and a brief description of : (A) Foliated and Lineated Rocks: Slate, Phyllite, Schist and Gneiss (B) Non-Foliated and Non-Lineated Rocks: Hornfels.

Textures and Structures of metamorphic rocks: (1) Non-Foliated Texture/Structure: Granoblastic , mosaic, Decussate, (2) Texture/Structure of Dynamic Metamorphism: Cataclastic, Mylonitic, Sutured and Augen (3) Texture/Structure of Regional Metamorphism: Foliation, Lineation, Crenulation, Schistose, Gneissose, Layering/banding.

Unit 4: Metamorphic grades: Isograd, Low, Medium, High and Very High. Geothermometry, Geobarometry, Index Minerals.

Metamorphic facies: Eskola's facies, Greenschist facies, Amphibolite facies, Granulite facies, Eclogite facies.

Effects of metamorphism: Effects of thermal metamorphism on Argillaceous Sediments and calcareous sediments. effects of regional metamorphism on argillaceous sediments and basic Igneous rocks.

References:

1. Petrology of Igneous and Metamorphic rocks by Hyndman
2. Principles of of Igneous and Metamorphic rocks by Anthony R. Philpotts.
3. Igneous petrology by Anthony Hall
4. Petrology of Igneous and Metamorphic rocks by Best.
5. Sedimentary Petrology – Pettijohn
6. Petrography – An introduction to the study of rocks in thin sections – H Kowell, Williams and Turner.
7. Hand book of subsurface geology – C.A. Moore
8. Sedimentary Petrology – Pettijohn
9. Principles of sedimentation – Twenhefel.
10. Sequence in layered rocks – Shrock, R.R
11. Procedures in sedimentary petrology – R.E. Carvar
12. Origin of sedimenrary rocks – Blatt, Middleton and Hurray.
13. Microscope sedimenraty petrology – A.V.Carrozi.
14. Sand and Sand Stones – Pettijohn, Potter and Siever.
15. Petrology of Sedimentary rocks – R.L.Folk.

B4-Petrology Practical

02 Credits

- Megascopic and Microscopic Identification and description of Plutonic ,Hypabyssal and volcanic igneous rocks.
- Megascopic and Microscopic Identification and description of Sedimentary rocks.
- Megascopic and microscopic Identification and description of Metamorphic rocks.
- Study of important Textures and Structures in Igneous, Sedimentary and Metamorphic rocks.

OPEN ELECTIVE-2

Medical Geology

03 Credits **3 hours per week**

UNIT -1

Foundations of medical geology :

Ancient findings, More recent findings, Environmental classification of elements in relation to public health ;inorganic poisons affecting public health in addition to pathogens with some examples from India ; developments in medical geology.

Environmental biology

Distribution of elements in Nature - A chemically variable earth; Mineral chemistry, diversity in the composition of rocks, biogeochemical cycle, establishing geochemical baselines, geochemical baseline map of India, Total composition and bioavailability, integrating epidemiological research with high quality geochemical composition of drinking water and food, agriculture and forest management.

UNIT 2:

Anthropogenic sources of contaminating elements: Mining, Mineral processing and metal refining; power generation, other industrial activities, waste disposal, agricultural practices, contamination from transport industry, atmospheric deposition of contaminants, contamination in urban environment, treatment and transport of drinking water.**Uptake of elements from chemical biological points of view, bioavailability of elements in soil**Gain knowledge about the medicinal value of various minerals by understanding the physical and chemical properties. Study the minerals that have health benefits or cause harm

Geological impacts on nutrition

Geological sources of nutrient elements, quantitative estimates of mineral needs, clinical assessment of mineral status, ecological aspects of mineral nutrients

UNIT -3

Pathways of exposure- Volcanic emissions and health, radon and U in water, Arsenic in water and environment, fluoride in drinking and irrigation water, health effects of hardness of water, selenium and iodine deficiency, selenium toxicity

Geophagy ; Soil borne pathogens

Natural aerosolic mineral dusts and human health – dust storms, pnemoconioses, lung diseases, silicosis, asbestosis . tuberculosis

Quality of groundwater

Thresholds for metal and non-metal ions from health point of view: as prescribed by : WHO, Bureau of Indian Standards, other international standards, AERB India, Methods of analysis of risk factors.

References

1. Selinus, Olle (Ed.), 2013, Essential of Medical Geology, Revised Edition. Springer.
2. Syed E. Hasan, 2020, Medical Geology, PMCID publications.
3. Carlos-Alberto Ríos-Reyes, María-Paula Ríos-Gutiérrez and Santiago Joya-Neira, Archivos de Medicina Volumen, 2021, The importance of minerals in medical geology: impacts of the environment on health. Enero-Junio de.