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| M.sc.,  geology |
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| **SYLLABUS** |
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| **from the acadmic year**  **2023-2024** |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |

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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** | |
| **Programme** | **M.Sc. Geology** |
| **Programme Code** |  |
| **Duration** | **PG - 2 years** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**  Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.  **PO2: Decision Making Skill**  Foster analytical and critical thinking abilities for data-based decision-making.  **PO3: Ethical Value**  Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.  **PO4: Communication Skill**  Ability to develop communication, managerial and interpersonal skills.  **PO5: Individual and Team Leadership Skill**  Capability to lead themselves and the team to achieve organizational goals.  **PO6: Employability Skill**  Inculcate contemporary business practices to enhance employability skills in the competitive environment.  **PO7: Entrepreneurial Skill**  Equip with skills and competencies to become an entrepreneur.  **PO8: Contribution to Society**  Succeed in career endeavors and contribute significantly to society.  **PO 9 Multicultural competence**  Possess knowledge of the values and beliefs of multiple cultures and  a global perspective.  **PO 10: Moral and ethical awareness/reasoning**  Ability to embrace moral/ethical values in conducting one’s life. |
| **Programme Specific Outcomes**  **(PSOs)** | **PSO1 – Placement**  To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.  **PSO 2 - Entrepreneur**  To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.  **PSO3 – Research and Development**  Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.  **PSO4 – Contribution to Business World**  To produce employable, ethical and innovative professionals to sustain in the dynamic business world.  **PSO 5 – Contribution to the Society**  To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

**Template for P.G., Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Hours** | **Semester-II** | **Credit** | **Hours** | **Semester-III** | **Credit** | **Hours** | **Semester–IV** | **Credit** | **Hours** |
| 1.1. Core-I | 5 | 7 | 2.1. Core-IV | 5 | 6 | 3.1. Core-VII | 5 | 6 | 4.1. Core-XI | 5 | 6 |
| 1.2 Core-II | 5 | 7 | 2.2 Core-V | 5 | 6 | 3.2 Core-VIII | 5 | 6 | 4.2 Core-XII | 5 | 6 |
| 1.3 Core – III | 4 | 6 | 2.3 Core – VI | 4 | 6 | 3.3 Core – IX | 5 | 6 | 4.3 Project with viva voce | 7 | 10 |
| 1.4 Discipline Centric  Elective -I | 3 | 5 | 2.4 Discipline Centric  Elective – III | 3 | 4 | 3.4 Core – X | 4 | 6 | 4.4Elective - VI (Industry / Entrepreneurship)  20% Theory  80% Practical | 3 | 4 |
| 1.5 Generic Elective-II: | 3 | 5 | 2.5 Generic Elective -IV: | 3 | 4 | 3.5 Discipline Centric Elective - V | 3 | 3 | 4.5 Skill Enhancement course / Professional Competency Skill | 2 | 4 |
|  |  |  | 2.6 NME I | 2 | 4 | 3.6 NME II | 2 | 3 | 4.6 Extension Activity | 1 |  |
|  |  |  |  |  |  | 3.7 Internship/ Industrial Activity | 2 | - |  |  |  |
|  | **20** | **30** |  | **22** | **30** |  | **26** | **30** |  | **23** | **30** |
| **Total Credit Points -91** | | | | | | | | | | | |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System**

**for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – I | 5 | 7 |
| Core – II | 5 | 7 |
| Core – III | 4 | 6 |
| Elective – I | 3 | 5 |
| Elective – II | 3 | 5 |
|  |  | **20** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – IV | 5 | 6 |
| Core – V | 5 | 6 |
| Core – VI | 4 | 6 |
| Elective – III | 3 | 4 |
| Elective – IV | 3 | 4 |
| Skill Enhancement Course [SEC] - I | 2 | 4 |
|  |  | **22** | **30** |

**Second Year – Semester – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – VII | 5 | 6 |
| Core – VIII | 5 | 6 |
| Core – IX | 5 | 6 |
| Core (Industry Module) – X | 4 | 6 |
| Elective – V | 3 | 3 |
| Skill Enhancement Course - II | 2 | 3 |
|  | Internship / Industrial Activity [Credits] | 2 | - |
|  |  | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – XI | 5 | 6 |
| Core – XII | 5 | 6 |
| Project with VIVA VOCE | 7 | 10 |
| Elective – VI (Industry Entrepreneurship) | 3 | 4 |
| Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |
| Extension Activity | 1 | - |
|  |  | **23** | **30** |

**Total 91 Credits for PG Courses**

**Course, Hours, Credits Index**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Part** | **Semester** | **Title of the Course** | **C/E/S** | **Credits** | **Hours** | **Marks** | | |
|  |  |  |  |  |  | **CIA** | **External** | **Total** |
| C | **SEMESTER I** | Physical Geology and Geomorphology | C | 5 | 7 | 25 | 75 | 100 |
| C | Mineralogy and Instrumentation Techniques | C | 5 | 7 | 25 | 75 | 100 |
| C | Mineralogy and Paleontology Practical | C | 4 | 6 | 40 | 60 | 100 |
| E | Elective Paper I – Stratigraphy of India and its Application (Mandatory) | E | 3 | 5 | 25 | 75 | 100 |
| E | Elective Paper II – Recent Trends in Paleontology (Optional) | E | 3 | 5 | 25 | 75 | 100 |
|  |  | **Total** |  | **20** | **30** |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C | **SEMESTER II** | Structural Geology and Geotectonics | C | 5 | 6 | 25 | 75 | 100 |
| C | a. Applied Remote Sensing and GIS  b. | C | 5 | 6 | 25 | 75 | 100 |
| C | Structural Geology and Geotectonics Practical and  Petrology Practical | C | 4 | 6 | 40 | 60 | 100 |
| E | Elective Paper III – Applied Petrology (Mandatory) | E | 3 | 4 | 25 | 75 | 100 |
| E | Elective Paper IV – Environmental Earth Science  (Optional) | E | 3 | 4 | 25 | 75 | 100 |
| S | Soft Skill II – Personality Development | S | 2 | 4 | 25 | 75 | 100 |
|  |  | **Total** |  | **22** | **36** |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C | **SEMESTER III** | Field Mapping | C | 5 | 6 | 25 | 75 | 100 |
| C | Geophysics | C | 5 | 6 | 25 | 75 | 100 |
| C | Hydrogeology | C | 5 | 6 | 25 | 75 | 100 |
| C | Geophysics and Applied Hydrogeology Practical | C | 4 | 6 | 40 | 60 | 100 |
| E | Elective Paper V – Economic Geology (or)  Disaster Management | E | 3 | 3 | 25 | 75 | 100 |
| I | NME |  | 2 | 3 |  |  |  |
| S | Internship / Industrial Activity |  | 2 | - |  |  |  |
|  |  | **Total** |  | **26** | **30** |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C | **SEMESTER IV** | Engineering and Mining Geology | C | 5 | 6 | 25 | 75 | 100 |
| C | Engineering, Mining Geology and Geochemistry Practical | C | 5 | 6 | 40 | 60 | 100 |
| Project | Project with Viva voce |  | 7 | 10 |  |  |  |
| E | Elective Paper VI – Oceanography and Climatology (Mandatory)  (or)  Petroleum Exploration and Mud logging | E | 3 | 4 | 25 | 75 | 100 |
| S | Skill Enhancement Course / Professional Competency Skill |  | 2 | 4 |  |  |  |
|  | Extension Activity |  | 1 | - |  |  |  |
|  |  | **Total** |  | **23** | **30** |  |  |  |

**SEMESTER – 1: Physical Geology and Geomorphology ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | |
| **CIA** | | **External** | **Total** |
|  | Physical Geology and Geomorphology | Core | Y | - | - | - | 4 | | 4 | 25 | | 75 | 100 |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To interpret natural processes which act on the Earth’s surface and the landforms. | | | | | | | | | | | | |
|  | To recall the types of landforms and quaternary landscapes | | | | | | | | | | | | |
|  | To employ geomorphological studies for structural and mineral exploration | | | | | | | | | | | | |
|  | To understand the pedochemical process responsible for the dissolution rate. | | | | | | | | | | | | |
|  | To identify different processes involved different geological landforms. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Earth and its internal structure, composition, size and shape. An overview of plate tectonics including elementary concepts of plates, lithosphere, asthenosphere, types of plate boundaries and associated important geological features like oceanic trenches, volcanic arcs, accretionary wedges, topography of mid-ocean ridges and transform faults. Palaeomagnetism and its application for determining palaeoposition of continents. Isostasy, Orogeny and Epeirogeny. | | | | | | | 12 | | | CO1 | | |
| II | Concepts of geomorphology. Landforms in relation to climate, rock type, structure and tectonics. Earthquakes and related landscape alterations, Seismic belts of the earth. Seismicity at plate boundaries. Principles of Geodesy. | | | | | | | 12 | | | CO2 | | |
| III | Geomorphic Processes – weathering, pedogenesis, mass movement, erosion, transportation and deposition. | | | | | | | 12 | | | CO3 | | |
| IV | Geomorphic landforms – fluvial, glacial, Aeolian, coastal, volcanoes and karst. | | | | | | | 12 | | | CO4 | | |
| V | Quaternary landscapes. Fluvial landscapes, Aeolian landscapes, coastal landscapes. | | | | | | | 12 | | | CO5 | | |
|  | **Total** | | | | | | | **60** | | |  | | |
| **Text Books** | | | | | | | | | | | | | |
| 1. | Holmes, D.L. (1981) Principles of Physical Geology.ELBS Edition. | | | | | | | | | | | | |
| 2. | Pethick, J. (1984) An Introduction to Coastal Geomorphology. Arnold, London. | | | | | | | | | | | | |
| 3 | Thornbury, W.D. (1969) Principles of Geomorphology.Wiley Eastern Ltd. | | | | | | | | | | | | |
| 4 | Richar Huggett, Fundamentals of Geomorphology | | | | | | | | | | | | |
| 5 | Strahler, A.N. (1952) Physical Geology. John Wiley & Sons Inc., New York. | | | | | | | | | | | | |

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| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | |
| 1. | Holmes, D.L. (1981) Principles of Physical Geology.ELBS Edition. |
| 2. | Pethick, J. (1984) An Introduction to Coastal Geomorphology. Arnold, London. |
| 3. | Thornbury, W.D. (1969) Principles of Geomorphology.Wiley Eastern Ltd. |
| 4. | Richar Huggett, Fundamentals of Geomorphology |
| 5. | Strahler, A.N. (1952) Physical Geology. John Wiley & Sons Inc., New York. |
| **Web Resources** | |
| 1. | <https://journals.sagepub.com/home/jom> |
| 2. | <https://www.americangeosciences.org/> |
| 3. | <https://www.egu.eu/> |
| 4. | <https://www.geosociety.org/> |

**Course outcome**:

CO1: Basic knowledge about the internatl structure of earth,

CO2: Students Studied the plate tectonics theory.

CO3: Get knowledge about the Landform: exogenic and endogenic processes •

CO4: Learn the Landform and tectonics • Drainage pattern, sea level change and geomorphic cycle.

CO5: Students can introduce the basis of Quaternary landscapes

**In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.**

**The S, M, L is based on the course outcome. The mapping is based on the revised Bloom’s Taxonomy Verbs used to describe your course outcome.**

* **Remember and Understanding – Lower level**
* **Apply and Analyze – Medium Level**
* **Evaluate and Create – Strong Level**

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 1 |
| **CO 4** | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester- I: Mineralogy and Instrumentation Techniques ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Mineralogy and Instrumentation Techniques** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Objectives** | | | |
|  | The students will be able to understand and explain the basic of mineral characteristics. | | |
|  | Will be able to employ their practical knowledge in further studies. | | |
|  | Can recall techniques for certain necessities. | | |
|  | Can evaluate the accuracy and summaries the methods adapted for certain practical activities. | | |
|  | Can explain and summarise problem. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Introduction to crystallography – Crystal systems – Symmetry elements – Isometric, Tetragonal, Orthorhombic, Hexagonal, Monoclinic and Triclinic systems – Normal classes. | 12 | CO1 |
| II | Stereographic projections – Axial ratio – Zones and zonal symbols – Tautozonal faces – Equation of the normal – Napier’s Theorem – Tangent relations – Sine ratio – Cosine ratio. | 12 | CO2 |
| III | Description and composition of the following mineral groups: Quartz, Feldspars, Feldspathoids, Micas, Garnets, Olivine, Pyroxenes, Amphiboles, Zeolites and Carbonate minerals. | 12 | CO3 |
| IV | Introduction to Optical Mineralogy Electrical, magnetic and optical properties of minerals – Properties of light – Transmissivity and Reflectivity – Polarization – Extinction – Dichroism – Pleochroism – Interference colors – Refringence and Birefringence – Order of interference – Conoscopy – Interference figures - Concepts of crystal field theory and mineralogical spectroscopy. | 12 | CO4 |
| V | Spot tests – Paper chromatography – Nephelometry – Turbidimetry – Spectroscopy – Flame photometry – X-ray spectroscopy – UV spectroscopy – Mass spectroscopy – Accelerated mass spectroscopy. | 12 | CO5 |
|  | **Total** | **60** |  |
| 1. | Donald Bloss F. (1971) Crystallography and Crystal Chemistry – An Introduction published by Holt, Rinehart and Winston, Inc., New York. | | |
| 2. | William M. Blackburn and William H. Dennen (1988) Principles of Mineralogy (Second Edition) published by WCB Publishers England. | | |
| 3. | Kerr P.F, Optical Mineralogy, 4th ed McGraw Hill New York (1977) | | |
| 4. | Gribble C.D. &A.J. Hall, A. Practical Introduction to Optical Mineralogy,Springer.London(1985) | | |
| 5. | Tisljar, S.K. Haldar, Josip (2013). Introduction to mineralogy and petrology. Burlington: Elsevier Science. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [9780124167100](https://en.wikipedia.org/wiki/Special:BookSources/9780124167100). | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Cornelis Klein and Cornelius S. Hurlbut, Jr. (1993) Manual of Mineralogy published by John Wiley & Sons, Inc. Singapore. | | |
| 2. | Paul F. Kerr (1967) Optical Mineralogy, John Wiley & Sons, New York. | | |
| 3. | Wenk, Hans-Rudolf; Bulakh, Andrey (2016). Minerals: Their Constitution and Origin. Cambridge University Press. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [9781316425282](https://en.wikipedia.org/wiki/Special:BookSources/9781316425282). | | |
| 4. | Whewell, William (2010). "Book XV. History of Mineralogy". History of the Inductive Sciences: From the Earliest to the Present Times. Cambridge University Press. pp. 187–252. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [9781108019262](https://en.wikipedia.org/wiki/Special:BookSources/9781108019262). | | |
| 5. | Laudan, Rachel (1993). From mineralogy to geology : the foundations of a science, 1650-1830 (Pbk. ed.). Chicago: University of Chicago Press. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [9780226469478](https://en.wikipedia.org/wiki/Special:BookSources/9780226469478). | | |
| **Web Resources** | | | |
| 1. | <https://mineralogy-ima.org/> | | |
| 2. | <https://www.socminpet.it/dwl.php?file=SIMP/GNM/SIMP_ELEM.pdf> | | |
| 3. | <https://www.mineralogicalassociation.ca/> | | |
| 4. | <https://www.cambridge.org/core/societies/mineralogical-society-of-great-britain-and-ireland> | | |
| 5. | <http://www.minsocam.org/> | | |

Course outcome

CO1: Basic knowledge on crystal structures and bonding and laws

CO2: student can learn about the Silicate structures and their physical and chemical properties

CO3: students get knowledge about the description and composition the minerals

CO4: Student gain knowledge on Optical mineralogical studies

CO5: student apply the instrumentation techniques in mineralogical studies

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 1 | 2 |
| **CO 2** | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 1 | 2 |
| **CO 3** | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 1 | 2 |
| **CO 4** | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 1 | 2 |
| **CO 5** | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 1 | 2 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-I: Stratigraphy of India and its Applications ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | |
| **CIA** | | **External** | **Total** |
|  | **Stratigraphy of India and its Applications** | Core | Y | - | - | - | 4 | | 4 | 25 | | 75 | 100 |
| **Course Objectives** | | | | | | | | | | | | | |
|  | Can recall the Stratigraphy of India. | | | | | | | | | | | | |
|  | Can differentiate different deposits of geological time. | | | | | | | | | | | | |
|  | To understand and compare different applications related to Stratigraphy. | | | | | | | | | | | | |
|  | Can interpret the sequence of stratigraphic column. | | | | | | | | | | | | |
|  | Can identify different processes involved during different geological time. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | **Stratigraphy of India –** Dharwar Supergroup – Mineral riches of Archaean. Cuddapah system and its mineral riches. Vidhyan system and its mineral riches. Cambrian System – Salt Range and Age of Saline Series. Ordovician and Silurian systems. | | | | | | | 12 | | | CO1 | | |
| II | **Stratigraphy of India (Contd.) -** Devonian system. Carboniferous system. The Gondwana Group – Structure of the Gondwana Basin – Climate and Sedimentation – Economic minerals in the Gondwanas. Upper Carboniferous and Permian systems – Triassic system – Lilang system - Jurassic system – Jurassic of Kutch - Cretaceous system – Cretaceous of Trichinopoly. | | | | | | | 12 | | | CO2 | | |
| III | **Stratigraphy of India (Contd**.) - Deccan traps – Lameta beds – Infra-trappean and Inter-trappean beds – Age of Deccan traps – Economic riches of Deccan traps. Tertiary group – Rise of the Himalayas – Eocene system and its Economic minerals – Oligocene and Lower Miocene systems and Petroleum – Middle Miocene and Lower Pleistocene – Siwalik system – Pleistocene and Recent – Culture, Climate and deposits in India – Human evolution and Culture – Glaciation and Human Culture – Chronology of Glaciation – Karewa formation – Potwar silts and Loess – Indo-Gangetic alluvium – Coastal deposits – Aeolian and other deposits – Recent deposits – Useful Mineral deposits of Pleistocene and Recent – Soils – Recent changes of level along the coast – Changes in the courses of rivers. | | | | | | | 12 | | | CO2 | | |
| IV | **Applications of Stratigraphy –** Geological time - Geologic time Units – Geochronology. Chronostratigraphy - Golden spikes – Global Standard Section and Point (GSSP) – Stratigraphic Units. Lithostratigraphy - Stratigraphic relationships - Lithostratigraphic Units – Lithodemic units – Application of Lithostratigraphy – Gaps in the record. Biostratigraphy – Fossils and Stratigraphy – Classification of organisms – Evolutionary trends – Biozones and Zone fossils – Taxa used in Biostratigraphy – Biostratigraphic correlation – Biostratigraphy in relation to other stratigraphic techniques. | | | | | | | 12 | | | CO2 | | |
| V | **Applications of Stratigraphy** (Contd.) - dating and correlation techniques – Radiometric dating – Application of radiometric dating – Other isotopic and chemical techniques – Chemostratigraphy – Magnetostratigraphy – Dating in the quaternary. Sequence stratigrphy - Sea-level changes – Sea level changes and sedimentation – Depositional sequences and systems tracts – Parasequences and its components of system tracts – Carbonate sequence stratigraphy – Sequence stratigraphy in non-marine basins – Alternative schemes in sequence stratigraphy – Applications of sequence stratigraphy – Causes of sea level fluctuations. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Geology of India and Burma M.S. Krishnan, (2010), 6th Edi., C.B.S publishers and Distributors, Delhi | | | | | | | | | | | | |
| 2. | Geology of India, D.N. Wadia, (1966), McMillan company, London | | | | | | | | | | | | |
| 3. | Vaidyanadhan.R&M.Ramakrishnan, Geology of India. Geological Society of India. Bangalore(2008) | | | | | | | | | | | | |
| 4. | Mehdiratta R.C,Geology of India, Pakisthan, Bangladesh and Burma. Atma Ram &Sons.Delhi(1974) | | | | | | | | | | | | |
| 5. | Geology& Mineral Resources of the States of India. Misc Pub.No.30.Geological Survey of India. Kolkota. (Several individual volumes available online at GSI portal) GSI(2005). | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Fundamentals of Historical Geology and Stratigraphy of India, Ravindrakumar (1985), Wiley Eastern ltd, New Delhi. | | | | | | | | | | | | |
| 2. | Principle of Stratigraphy, Dunbar and Roggers, (1964), John Wiley and co, New York | | | | | | | | | | | | |
| 3. | An Introduction in Stratigraphy, Stamp L.D, (1964), Thomas Murby, Museum St, WCI, London. | | | | | | | | | | | | |
| 4. | Stratigraphic Principles and Practices, Weller, J.M, (1962), Harper & Bros, New York | | | | | | | | | | | | |
| 5. | Kumar R,Fundamentals of Historical Geology and Stratigraphy of India,WiIey.New Delhi (1988). | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | https://stratigraphy.org/ | | | | | | | | | | | | |
| 2. | https://www.sepm.org/ | | | | | | | | | | | | |
| 3. | https://www.geosocindia.org/ | | | | | | | | | | | | |
| 4. | https://www.moes.gov.in/ | | | | | | | | | | | | |
| 5. | https://isegindia.org/ | | | | | | | | | | | | |

**Course outcomes:**

CO1: Students studied and gain knowledge on Dharwar Supergroup – Mineral riches of Archaean.

CO2: Students able to understand about the Gondwana Group and its stratigraphy

CO3: Students get knowledge on Deccan traps

CO4: Students understand the Stratigraphy of India

CO5: Students used to study the Applications of Stratigraphy

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO 2** | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO 3** | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-I : Recent Trends in Paleontology (Elective) ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Recent Trends in Paleontology (Elective)** | Elective | Y | - | - | - | 3 | 4 | 25 | 75 | 100 |

|  |  |
| --- | --- |
| **Course Objectives** | |
|  | Learn about the origin and evolution of life, understanding species concept and study of the major events in the history of Precambrian and Phanerozoic life. Detailed study about vertebrate paleontology. |
|  | Learn about the morphology, classification, evolutionary trend, composition and structure of shells of selected groups of organisms. |
|  | To explain about geological history, geographical distribution and description of more important genera |
|  | Demonstrating the sampling methods and sample processing techniques of micropaleontology. |
|  | To know about the application of micropaleontology in hydrocarbon exploration. |

|  |  |  |  |
| --- | --- | --- | --- |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Fossil record and geological time-scale. Evolutionary changes in molluscs and mammals in geological time. Principles of evolution.Use of species and genera of foraminifera and Echinodermata in biostratigraphic correlation. Different microfossil groups and their distribution in India. Functional morphology, evolution and significance of Plant Fossils, Fishes, Horse, Elephant and Man. Dinosaurs and their extinction. Taphonomy and environmental factors, Oxygen and Carbon isotope studies of fossils and paleoclimates – Palaeobiogeographic Provinces. | 12 | CO1 |
| II | Theories on origin and evolution of life – Phylogenetic and Ontogenic Analysis – Species Concept – Types of Fossils and Types of Species – Palingensis – Coenogensis – Proterogenesis - Thanatocoenosis – Biocoenosis – Sidocoenosis - Biomineralisation and Trace Fossils – Fossils and their uses – Biometrics – Major events in the history of Precambrian and Phanerozoic life. | 12 | CO2 |
| III | Vertebrate paleontology: Succession of vertebrate life through geologic time. Broad classificationand study of some characteristic Indian vertebrate genera.Indian pre-Tertiary vertebrate - their distribution and paleogeographic implication; extinction of dinosaurs.Indian Tertiary vertebrate - Siwalik mammals; phylogeny - Equidae and Proboscidae.Indian fossil Hominoides and modern theories regarding human evolution. | 12 | CO2 |
| IV | Invertebrate paleontology: an overview. Morphology, classification, evolutionary trend, composition and structure of shells of selected groups of organisms - Porifera, Bryozoa, Mollusca, Brachiopoda.Geological history, geographical distribution and description of more important genera of Trilobita, Echinoides, Coelenterata and Graptoloidea. | 12 | CO2 |
| V | Micropaleontology: Sampling methods and sample processing techniques. Types of microfossils.Calcareous Microfossils - Foraminifera - major morphologic groups; Benthic Foraminifera; depth biotopes, value in paleobathymetric determination. Larger foraminifera – their utility in Indian stratigraphy.Planktonic foraminifera and calcareous nannofossils.Ostracoda - outline morphology, paleoecology & geological history. Brief knowledge about pteropods, calpionellids and calcareous algae.Application of micropaleontology in hydrocarbon exploration. | 12 | CO2 |
|  | **Text Books** | | |
| 1. | Palaeontology Evolution and animal distribution. .C. Jain and M.S. Anantharaman, (1996), Vishal Publications, Jalandhar. | | |
| 2. | Invertebrate Palaeontology - H.Woods, (1985), CBS Publishers and Distributors, New Delhi. | | |
| 3. | Agashe, S.N, Paleo botany, Oxford & IBH. Delhi(1995) | | |
| 4. | Stewart W.N. & G.W. Rothwell, Palaeobotany, Cambridge University Press. D 2005) | | |
| 5. | Moore R.C. et al., Invertebrate Fossils. CBS. Delhi (1952). | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Principles of Invertebrate Palaeontology, Shrock R.R and Twenohofel W.H, (2005), CBS Publishers and Distributors, New Delhi. | | |
| 2. | Invertebrate Fossils. Moore R.C, Lalicker C.G and Fisher A.G (1952) McGraw Hill. | | |
| 3. | The Vertebrate Story, Romer A.S, (1959) University of Chicago Press, 4thEdt. Chicago. | | |
| 4. | Palaeontology An Introduction, E.W.Nield and V.C.T.Tucker (1985) Pergamon Press, Oxford. | | |
| 5. | Colbert E.H. et al.,Evolution of the Vertebrates, Wiley. New Delhi 2002) | | |
| **Web Resources** | | | |
| 1. | <https://en.wikipedia.org/wiki/Age_of_Earth> | | |
| 2. | <https://www.lyellcollection.org/doi/10.1144/GSL.SP.2001.190.01.14>. | | |
| 3. | <https://digitalatlas.cose.isu.edu/geo/basics/fossil.htm> | | |
| 4. | <https://www.sciencedirect.com/topics/immunology-and-microbiology/hemichordata> | | |
| 5. | <https://www.qm.qld.gov.au/Explore/Research/Biodiversity> | | |

Course outcome:

CO1: Student can understand about the fossil record and geological time-scale

CO2:To get knowledge about the theory and Origin of life

CO3: Stundents get more knowledge about vertebrate paleontology

CO4: Stundents get more knowledge about Invertebrate paleontology

CO5: Student gain knowledge on micropaleontology: Sampling methods and sample processing techniques

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO 2** | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO 3** | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-I: Laws of Life (Soft Skills) (Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Laws of Life (Soft Skills)** | Soft Skill | Y | - | - | - | 2 | 4 | 25 | 75 | 100 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Objectives** | | | |
|  | The student can differentiate between average people and effective people. | | |
|  | Can critically assess him/her | | |
|  | Can review his/her attitude and identify the strength and weakness. | | |
|  | Can recall failures and success in his/her life. | | |
|  | Can compare and contrast as well as evaluate him/her. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | **Habit, They make you or Break you**- Habits - The seven Habits of Highly effective teens: Private victory, Public victory, Renewal. Paradigms and Principles- Paradigm shift - Paradigm of self - Paradigm of others - Paradigms of life - Principles that never fail - Baby steps for achieving larger goals. | 12 | CO1 |
| II | **The private victory-**The Personal Bank Account (PBA): Deposits and withdrawals. Be proactive**-** Proactive or Reactive - Circle of Control - can do people - Can’t do people - Just push pause - Self-awareness – Imagination - Will power. | 12 | CO2 |
| III | **Begin with the end in mind-** Create an outline - The crossroads of life; Personal mission statement - Uncovering your talents; The great discovery - Your mission statement; Three watch-outs; Go for the goals with five keys; Turning weakness into strengths; Make your life extraordinary - Put first things first. | 12 | CO2 |
| IV | **The public victory**- The Relationship Bank Account (RBA) - Do small act of kindness; Think win-win; Seek first to understand, then to be understood- Five poor listening styles; Synergize - the High way – Celebrate your own diversity – Getting to synergy action plan. | 12 | CO2 |
| V | **Sharpen the saw -** It’s me time-Renewal - Balance is better; Caring your body – Caring your brain: Sharpen your mind - Caring your heart – Caring your soul; Keep hope alive - all begins with a single step. | 12 | CO2 |

|  |  |
| --- | --- |
|  | **Text Books**  **(Latest editions)** |
| 1. | Sean Covey. 2014. *The 7 Habits of Highly Effective Teenagers.* Simon & Schuster UK Ltd. London. E-book ISBN: 978-0-85720-647-3. |
| 2. | Dale Carnegie. 1936. *How to win Friends and Influence People*. Golden Minds Publishing House. Mumbai. ISBN: 978-93-86341-17-4. |
| 3. | [Pizer, Donald](https://en.wikipedia.org/wiki/Donald_Pizer), 1966. Realism and Naturalism in Nineteenth-Century American Literature. Carbondale: Southern Illinois University Press. |
| 4. | McClintock, James. 1975. White Logic: Jack London's Short Stories. Grand Rapids, Michigan: Wolf House Books. |
| 5. | [Pontifical Council for the Family. The Family and Human Rights](https://www.vatican.va/roman_curia/pontifical_councils/family/documents/rc_pc_family_doc_20001115_family-human-rights_en.html) [Archived](https://web.archive.org/web/20080319014620/https:/www.vatican.va/roman_curia/pontifical_councils/family/documents/rc_pc_family_doc_20001115_family-human-rights_en.html) 2008-03-19 at the [Wayback Machine](https://en.wikipedia.org/wiki/Wayback_Machine) Vatican website. Retrieved 2011-07-09. |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | |
| 1. | Stephen R Covey. 2004. *The 7 Habits of Highly Effective People.* Simon & Schuster UK Ltd. London. ISBN: 13: 978-1-4165-0249-4. |
| 2. | Stephen R Covey. 1997. The 7 Habits of Highly Effective Families. Simon & Schuster UK Ltd. London. ISBN: 978-0-684-86008-4. |
| 3. | [Pizer, Donald](https://en.wikipedia.org/wiki/Donald_Pizer), 1966. Realism and Naturalism in Nineteenth-Century American Literature. Carbondale: Southern Illinois University Press. |
| 4. | McClintock, James. 1975. White Logic: Jack London's Short Stories. Grand Rapids, Michigan: Wolf House Books. |
| 5. | [Pontifical Council for the Family. The Family and Human Rights](https://www.vatican.va/roman_curia/pontifical_councils/family/documents/rc_pc_family_doc_20001115_family-human-rights_en.html) [Archived](https://web.archive.org/web/20080319014620/https:/www.vatican.va/roman_curia/pontifical_councils/family/documents/rc_pc_family_doc_20001115_family-human-rights_en.html) 2008-03-19 at the [Wayback Machine](https://en.wikipedia.org/wiki/Wayback_Machine) Vatican website. Retrieved 2011-07-09. |
| **Web Resources** | |
| 1. | <https://en.wikipedia.org/wiki/Moral_agency> |
| 2. | <https://en.wikipedia.org/wiki/Moral_rights> |
| 3. | <https://en.wikipedia.org/wiki/Moral_skepticism> |
| 4. | [<https://www.nrlc.org/>](https://en.wikipedia.org/wiki/National_Right_to_Life_Committee) |
| 5. | <https://en.wikipedia.org/wiki/Haleigh_Poutre> |

**Course outcome**:

CO1: Students learn the seven Habits of Highly effective teens

CO2: Students gain knowledge on Private victory

CO3: Student learn the begin with the end in mind

CO4: Student understand the knowledge on the public victory

CO5: Student understand the Sharpen the saw

The Relationship Bank Account, Self-awareness – Imagination - Will power.

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 |
| **CO 2** | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 |
| **CO 3** | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 |
| **CO 4** | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 |
| **CO 5** | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester- II: Structural Geology and Geotectonics ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Structural Geology and Geotectonics** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Objectives** | | | |
|  | The student can interpret and evaluate different structures that exist in the earth. | | |
|  | Can critically assess and review the energy needed to cause different structures. | | |
|  | Can describe and explain major and minor structures. | | |
|  | Can understand to compare and contrast structures related to each other. | | |
|  | Can evaluate and explain the causes of different structures. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Theory of stress and strain – Behavior of rocks under stress – Mohr’s circle – Various states of stress and their representation by Mohr’s circles – Different types of failure and sliding criteria – Geometry and mechanics of fracturing and conditions for re-activation of pre-existing discontinuities – Paleostress analysis – Common types of finite strain – Ellipsoids – L-, L-S-, and S-tectonic fabrics. | 12 | CO1 |
| II | Techniques of strain analysis – Particle paths and flow patterns – Progressive strain history and methods for its determination. Deformation mechanisms – Role of fluids in deformation processes – Geometry and analysis of brittle-ductile and ductile shear zones – Petrofabric analysis – Field and laboratory techniques – Point and percentage diagrams – Preparation of petrofabric diagrams of quartz, biotite and calcite – Symmetry of fabric – Symmetry of movement. | 12 | CO2 |
| III | Rotated minerals – Syn-, pre- and post-kinematic – Differential movement in rocks using rotated minerals – Oscillatory movements – Characteristics – Neotectonics – Indian and global evidences – Methods of study of neotectonics. Sheath folds – Geometry and mechanics of development of folds – Boudins – Foliation and lineation – Interference patterns and structural analysis in areas of superposed folding – Fault-related folding – Geometry and mechanics of faults – Gravity-induced structures. | 12 | CO2 |
| IV | Major tectonic features and associated structures in extensional-, compressional-, and strike-slip terrains – Joints and unconformities – Penecontemporaneous deformational structures of sedimentary rocks. Plate tectonics – Concept and principles – Continental drift – Geological and geophysical evidences – Mechanics, objections and present status of plate tectonics. | 12 | CO2 |
| V | Gravity and magnetic anomalies at mid-oceanic ridges, deep sea trenches, continental shield areas and mountain chains – Geological and geophysical characteristics of plate boundaries – Geodynamic evolution of the Himalayas – Paleomagnetism – Sea floor spreading and plate tectonics – Island arcs, oceanic islands and volcanic arcs – Isostasy, orogeny and epeirogeny – Geodynamic of the Indian Plate. | 12 | CO2 |
|  | **Text Books**  **(Latest Editions)** | | |
| 1. | Billings, M.P. (2014) *Structural Geology*. Prentice-Hall, Inc., Learning Pvt. Ltd., Delhi. 3rd Edition. ISBN: 978-81-203-0059-03. | | |
| 2. | Beloussov, V.V. (1962).*Basic Problems in Geotectonics*. McGraw-Hill Book Co., New York. | | |
| 3 | Badgeley, P.C. (1965) *Structural and Tectonic Principles*. Harper & Row Publishers, New York. ASIN: BOOBXTMTK6. | | |
| 4 | Twiss, R.J. and Moores, E.M. (2007).*Structural Geology*. W.H.Freeman and Company, New York. 2nd Edition. ISBN: 10: 0-7167-4951- | | |
| 5 | B.A. van der Pluijm and S. Marshak (2004). [Earth Structure - An Introduction to Structural Geology and Tectonics](http://globalchange.umich.edu/ben/ES/earthstructure.htm) (2nd ed.). New York: [W. W. Norton](https://en.wikipedia.org/wiki/W._W._Norton). p. 656. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-393-92467-X](https://en.wikipedia.org/wiki/Special:BookSources/0-393-92467-X). | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Suppe, J. (1985) *Principles of Structural Geology*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. ISBN: ISBN 0137105002. | | |
| 2. | Marshak, S. and Mitra, G. (1988) *Basic Methods of Structural Geology*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. ISBN: 0130651788. | | |
| 3. | M. King Hubbert (1972). Structural Geology. Hafner Publishing Company. | | |
| 4. | G.H. Davis and S.J. Reynolds (1996). The structural geology of rocks and regions (2nd ed.). [Wiley](https://en.wikipedia.org/wiki/John_Wiley_%26_Sons). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-471-52621-5](https://en.wikipedia.org/wiki/Special:BookSources/0-471-52621-5). | | |
| 5. | C.W. Passchier and R.A.J. Trouw (1998). Microtectonics. Berlin: [Springer](https://en.wikipedia.org/wiki/Springer_Science%2BBusiness_Media). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [3-540-58713-6](https://en.wikipedia.org/wiki/Special:BookSources/3-540-58713-6). | | |
| **Web Resources** | | | |
| 1. | http://www.labotka.net | | |
| 2. | <http://www.patnasciencecollege.org> | | |
| 3. | <https://geomorphology.org.uk> | | |
| 4. | <https://gradeup.co> | | |
| 5. | https://www.nps.gov>subjects>gla | | |

**Course outcome**:

CO1:To gain knowledge about the geological structures like fold, fault, unconformity, foliation and lineation and its causes and mechanisms.

CO2: Gain knowledge on techniques of strain analysis

CO3: Student learn about the Methods of study of neotectonics

CO4: Student understand on Major tectonic features and associated structures in extensional-, compressional-, and strike-slip terrains – Joints and unconformities

CO5: Student gain knowledge on Gravity and magnetic anomalies at mid-oceanic ridges, deep sea trenches, continental shield areas and mountain chains.

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 2** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| **CO 5** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**SEMESTER-II: Applied Remote Sensing and GIS ( Ist Year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Applied Remote Sensing and GIS** | Core | Y | - | - | - | 2 | 4 | 25 | 75 | 100 |

|  |  |  |  |
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| **Course Objectives** | | | |
|  | Understand the basics of remote sensing, electromagnetic radiation (EMR) and its properties, aerial photography and to list the important merits of these technology tools. | | |
|  | Students will comprehend the core part of remote sensing i.e. spectral properties of earth objects, interaction of EMR with the atmosphere and the acquisition of data by different satellite sensors including the generate of False Color Composite (FCC) imagery. | | |
|  | Based on the understanding of the basics, the students are expected to do thorough interpretation of aerial photographs and FCC imagery for the preparation of various thematic maps. | | |
|  | Acquiring advanced skills on the aspects of digital image processing and the Spatial Information Technology tools, the students are expected to do quantitative analysis on change detection, monitoring of resources etc. | | |
|  | Evaluate the importance of these technology tools over conventional techniques and its way forward. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Fundamentals of remote sensing: History of remote sensing technology – Remote sensing system – Electromagnetic radiation – Spectral properties of terrestrial objects – Analysis of spectral reflectance curves – Types of satellites – Image acquisition – Multi-spectral scanners – Remote sensing resolution – Introduction to thermal remote sensing – Introduction to microwave remote sensing and new satellite sensors – Remote sensing in landform and land use mapping, structural mapping, coastal and ocean studies – Global and Indian space missions. | 12 | CO1 |
| II | Aerial photography: Introduction – Vertical and oblique photographs – Photoscale – Image displacement due to relief – Parallax in aerial photographs – Aerial photographic procedures – Camera and flight requirement – Flight planning – Filters – Compensation – Stereoscopy – Photomosaics. Photographical studies – Photo recognition elements and keys – Interpretation of lithology, structures and landforms from aerial photographs. | 12 | CO2 |
| III | Image processing in remote sensing: Digital data recording – Digital data format. Introduction to digital image processing – Pre-processing techniques – Image classification methods – Image enhancement techniques. | 12 | CO2 |
| IV | Applications of remote sensing: Visual interpretation – Different sensors – Data and image interpretation key elements. Exercises on mapping of geology – Land use/land cover and geomorphology based on visual method – Preparation of base maps and transformation of thematic maps. Validation of remote sensing analysis output by ground truth – Accuracy, estimation and introduction to GPS technology. | 12 | CO2 |
| V | Fundamentals and application of GIS: Concept of GIS – GIS types – Data storage – Retrieval and analysis. GIS database organization and development – Combined use of remote sensing and GIS. Preparation of spatial decision support system (SDSS).Highlights on different applications using GIS tool with particular reference to Applied Geosciences and Ocean Science. | 12 | CO2 |
|  | **Text Books** | | |
| 1. | Asrar, G. (1989) *Theory and Applications of Optical Remote Sensing*. John Wiley & Sons, New York. | | |
| 2. | Curran, P.J. (1984) *Principles of Remote Sensing*. Longman Group Ltd. | | |
| 3 | Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2007) *Remote Sensing and Image Interpretation.* Wiley India, 763. | | |
| 4 | Paul R. Wolf. (1986) *Elements of Photogrammetry*, McGraw-Hill Book company. 628. | | |
| 5. | Lasaponara, R. and [Masini N.](https://en.wikipedia.org/wiki/Nicola_Masini) 2012: Satellite Remote Sensing - A new tool for Archaeology. Remote Sensing and Digital Image Processing Series, Volume 16, 364 pp., [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-90-481-8801-7](https://en.wikipedia.org/wiki/Special:BookSources/978-90-481-8801-7). | | |

|  |  |
| --- | --- |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | |
| 1. | Sabins, F.F. (1998) *Remote Sensing Principles and Interpretation*. W.H.Freeman& Co |
| 2. | Agarwal, C.S. and P.K. Garg (2000) *Textbook on Remote Sensing In natural resources monitopring and management,* Wheeler Publishing, 196. |
| 3. | Campbell, J. B. (2002). Introduction to remote sensing (3rd ed.). The Guilford Press. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-1-57230-640-0](https://en.wikipedia.org/wiki/Special:BookSources/978-1-57230-640-0). |
| 4. | Jensen, J. R. (2007). Remote sensing of the environment: an Earth resource perspective (2nd ed.). Prentice Hall. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-0-13-188950-7](https://en.wikipedia.org/wiki/Special:BookSources/978-0-13-188950-7). |
| 5. | Richards, J. A.; X. Jia (2006). Remote sensing digital image analysis: an introduction (4th ed.). Springer. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-3-540-25128-6](https://en.wikipedia.org/wiki/Special:BookSources/978-3-540-25128-6). |
| **Web Resources** | |
| 1. | https://stratigraphy.org/ |
| 2. | https://www.sepm.org/ |
| 3. | https://www.geosocindia.org/ |
| 4. | https://www.moes.gov.in/ |
| 5. | https://isegindia.org/ |

Course outcome:

CO1: To gain the basic concept of remote sensing

CO2: Students study the Photogeology

CO3: Student get knowledge on Image processing in remote sensing

CO4: Students learn about the Applications of remote sensing

CO5: Students gain knowledge on Fundamentals and application of GIS

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | S | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | S | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | S | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 |
| **CO 4** | S | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | S | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-II: Field Mapping ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | |
| **CIA** | | **External** | **Total** |
|  | **Field Mapping** | Core | Y | - | - | - | 4 | | 4 | 25 | | 75 | 100 |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To identify and list out the issues and problems | | | | | | | | | | | | |
|  | To describe and explain the solution to follow | | | | | | | | | | | | |
|  | To interpret and calculate through different procedures to find out solution | | | | | | | | | | | | |
|  | To select a particular solution for some specific problems | | | | | | | | | | | | |
|  | To review an idea regarding solution for a problem | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Use of clinometer compass for geographic directions, taking bearing and back bearing, strike and dip, reading of and locating oneself on toposheet – Use of GPS for co-ordinates and mapping of features (One day) – Geomorphological mapping (One day). | | | | | | | 12 | | | CO1 | | |
| II | Visit to igneous rock outcrops for mapping, collection of rock samples and field set-up studies (Two days) – Mapping of dikes and veins – Thin section studies of rocks (One day). | | | | | | | 12 | | | CO2 | | |
| III | Visit to sedimentary terrain for mapping of strata and collection of fossils (Two days). | | | | | | | 12 | | | CO2 | | |
| IV | Visit to metamorphic terrain for mapping of rocks and metamorphic structures, collection of rock samples (Two days) – Thin section studies (One day). | | | | | | | 12 | | | CO2 | | |
| V | Geophysical investigations – Field measurements using gravity, magnetic and electrical methods (Two days). | | | | | | | 12 | | | CO2 | | |
|  |  | | | | | | | | | | | | |
| 1. | Brian Simpson. (1968).*Geological Maps*. Pergamon Press Limited, Oxford. | | | | | | | | | | | | |
| 2. | Lisle, R.J. (1988).*Geological Structures and Maps*. Pergamon Press, Oxford. | | | | | | | | | | | | |
| 3 | Gass, J.G., Butcher, N.E., Clark, P., Francis, P.W., Jackson, D.E., McCurry, P., Skipsey, E., Smith, P.J., Stevenson, J., Thorpe, R.S., Turner, C., Wilson, R.C.L., Wright, J.B. (1972). *Field Relations – A Second Level Course in Science*. The Open University Press, London | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Thomas, J.A.G. (1977).*An Introduction to Geological Maps*. George Allen and Unwin (Publishers) Limited, London. 2nd Edition. | | | | | | | | | | | | |
| 2. | Bhattacharya, D.S. and Bagchi, T.C. (1973).*Elements of Geological Map Reading and Interpretation with Exercises*. Orient Longman Limited, Calcutta | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | <https://pubs.geoscienceworld.org/jgs> | | | | | | | | | | | | |
| 2. | <https://www.geosocindia.org/index.php/gsi/pages/view/ed> | | | | | | | | | | | | |
| 3. | <https://www.gsi.gov.in/webcenter/portal/OCBIS> | | | | | | | | | | | | |

**Course outcome**:

CO1: Student apply the knowledge on use of clinometer compass for geographic directions

CO2: Students studied practically on the collection of rock samples and field set-up studies

CO3: Students can get the field exposure and field knowledge for identification of rock types

CO4: Students studied the mapping of rocks and metamorphic structures

CO5: Student trained the Geophysical investigations using geophysical instruments

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 2** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 3** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 4** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester- II: Structural Geology and Geotectonics Practical ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Structural Geology and Geotectonics Practical** | Core | Y | - | - | - | 4 | 4 | 40 | 60 | 100 |

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| --- | --- | --- | --- |
| **Course Objectives** | | | |
|  | To identify and list out the issues and problems. | | |
|  | To describe and explain the solution to follow | | |
|  | To select a particular solution for some specific problems. To interpret and calculate through different procedures to find out solution | | |
|  | To review an idea regarding solution for a problem. | | |
|  | To different between different structures. To conceive and conceptualize the solutions arrived at. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Determination of attitude of beds – Geometrical, graphical and trigonometric projections – Tabular and nomograph methods. | 12 | CO1 |
| II | Reconstruction of parallel fold and fault – Preparation and analysis of structure contour map – Isopachs. | 12 | CO2 |
| III | Construction of perpendicular and vertical sections of plunging fold. Geochronology – Pi and beta diagrams – Structural complex – | 12 | CO2 |
| IV | Depth to strata – True thickness of beds - Interpretation of geological maps involving normally dipping beds, bore well data. | 12 | CO2 |
| V | Interpretation of geological maps involving symmetrical and asymmetrical fold, isoclinal fold, recumbent fold, plunging fold, strike fault and step fault. | 12 | CO2 |
|  | **Text books** | | |
| 1. | Brian Simpson. (1968).*Geological Maps*. Pergamon Press Limited, Oxford. | | |
| 2. | Lisle, R.J. (1988).*Geological Structures and Maps*. Pergamon Press, Oxford. | | |
| 3 | Gass, J.G., Butcher, N.E., Clark, P., Francis, P.W., Jackson, D.E., McCurry, P., Skipsey, E., Smith, P.J., Stevenson, J., Thorpe, R.S., Turner, C., Wilson, R.C.L., Wright, J.B. (1972). *Field Relations – A Second Level Course in Science*. The Open University Press, London. | | |
| 4. | Structural geology, Billing. M.P. (1974), Prentice Hall, New Delhi | | |
| 5. | An outline of Structural Geology, Hobbs, B.E., Means, W.D. and Williams, P.F. (1976):, John Wiley, New York. | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Bhattacharya, D.S. and Bagchi, T.C. (1973).*Elements of Geological Map Reading and Interpretation with Exercises*. Orient Longman Limited, Calcutta. | | |
| 2. | Gokhale, N.W. (2006).*A Manual of Problems in Structural Geology*. CBS Publishers and Distributors, New Delhi. | | |
| 3. | Basic Problems of Geotectonics Belousov.V.V. (1962):, McGraw Hill, New York | | |
| 4. | Structural Geology De Sitter. L.U. (1956):, McGraw Hill, New York | | |
| 5. | Elements of Structural Geology Hill. E.S. (1972):, John Wiley, New York | | |
| **Web Resources** | | | |
| 1. | https://stratigraphy.org/ | | |
| 2. | https://www.sepm.org/ | | |
| 3. | https://www.geosocindia.org/ | | |
| 4. | https://www.moes.gov.in/ | | |
| 5. | https://isegindia.org/ | | |

**Course outcome**:

CO1: Students workout on the determination of attitude of beds

CO2: Student gain knowledge on preparation and analysis of structure contour map

CO3: Students learn about the Construction of perpendicular and vertical sections of plunging fold

CO4: Students gain knowledge on find out the true thickness and vertical thickness of beds

CO5: Interpretation of geological maps

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 2** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 3** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 4** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 1 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-II- Petrology Practical ( Ist year)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Petrology Practical** | Core | Y | - | - | - | 4 | 4 | 40 | 60 | 100 |

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| **Course Objectives** | | | |
|  | To compare and contrast different rock types by means of megascopic and microscopic studies. | | |
|  | To enhance the knowledge about minerals in rocks using petrographic techniques | | |
|  | To carry out grain size analysis to distinguish genesis. | | |
|  | To carry out grain size analysis to distinguish depositional environments. | | |
|  | To carry out gravel analysis to establish of paleofluvial channels and provenance. | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Megascopic and microscopic study (textural and mineralogical) of the following igneous rocks: Granite, Syenite, Gabbro, Basalt, Peridotite, Pyroxenite, Dunite. Lamprophyres, Dolerite, Phonolite, Rhyolite, Trachyte, Andesite, Pitchstone, Anorthosite, Aplite, Pegmatite. Introduction to modal analyses of Granite, Basalt and Gabbro. | 12 | CO1 |
| II | Megascopic and microscopic study (textural and mineralogical) of the following metamorphic rocks: Low grade metamorphic rocks: serpentinites, albite-epidote-chlorite-quartz schist, slate, talc-tremolite-calcite-quartz schist. Medium to high grade metamorphic rocks: Gneisses, amphibolite, hornfels, garnetiferous schists, sillimanite-kyanite-bearing rocks, Granulites, eclogite, diopside-forsterite marble. Laboratory exercises in graphic plots for petrochemistry and interpretation of paragenetic diagrams. | 12 | CO2 |
| III | Megascopic and microscopic study (textural and mineralogical) of the following Sedimentary rocks: Sand stone, Lime stone, Conglomerate, Arkose, mud rocks. | 12 | CO2 |

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| IV | Harker’s, Larsen’s variation diagrams – Peacock’s Alkali-Lime Index – Niggli’s variation diagram – | 12 | CO2 |
| V | Preparation of Thin sections – Grain size analysis – Statistical parameters in Sedimentology – Frequency and cumulative frequency distribution curves – Moment and graphic measures – Gravel analysis. | 12 | CO2 |
|  |  | | |
| 1. | Vernon R. H. and Clarke G. L. 2008. Principles of metamorphic Petrology. Cambridge publication. | | |
| 2. | John D. Winter 2001. An Introduction to Igneous and Metamorphic Petrology. | | |
| 3. | Wenk,H.R&A. Bulakh, Minerals, Cambridge University Press,New Delhi(2006) | | |
| 4. | Perkins D, 3rd ed. Prentice Hall India, NewDelhi(2010) | | |
| 5. | HaIdar,S.K.&J.Tisjlar, Introduction to Mineralogy and Petrology, Elsevier,(2014) | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Yardley, B W D. 1990. An introduction to metamorphic petrology. ELBS publication. | | |
| 2. | Best, M.G. 2002. Igneous and metamorphic petrology. Wiley publication. | | |
| 3. | An Introduction to Rock forming Minerals, Deer, Howie and Hussmann, (1982), 2nd Edit., Orient Longman, London. | | |
| 4. | Deer,W.A.,R.A.Howie&J.Zussman. An Introduction to the Rock-Forming Minerals. ELBS.London(1992) | | |
| 5. | Berry L.G.,B.Mason &R.V. Dietrich, Mineralogy, CBS New Delhi (1985). | | |
| **Web Resources** | | | |
| 1. | https://en.m.wikipedia.org/wiki/mineral | | |
| 2. | https://britannica.com/science/chlorite-mineral | | |
| 3. | https://mineralseducationcoalition.org/minerals-database/zeolite | | |
| 4. | https://www.britannica.com/science/epidote | | |
| 5. | <https://www.abracom.es> | | |

**Course outcome:**

**CO1** Study theMegascopic and microscopic study for igneous rocks

**CO2** Study theMegascopic and microscopic study for sedimentary rocks

**CO3** Megascopic and microscopic study for metamorphic rocks

**CO4** Statistical parameters in Sedimentology

**CO5** Preparation of Thin sections

(textural and mineralogical) of the following igneous rocks, metamorphic rocks and sedimentology rocks. is also studied

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 |
| **CO 3** | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester II- Applied Petrology ( I year)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | **Inst. Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
|  | **Applied Petrology** | Core | Y | - | - | - | 4 | 4 | 25 | 75 | 100 |

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| --- | --- | --- | --- |
| **Course Objectives** | | | |
|  | Understanding the basics of the Earth as a System. | | |
|  | To analyze various magmatic compositions to understand the formation of various igneous rocks. | | |
|  | To comprehend the genesis of metamorphic rocks. | | |
|  | To understand the formation of sedimentary rocks, their depositional environments and provenance | | |
|  | Understanding the complete system of the Earth | | |
| **UNIT** | **Details** | **No. of Hours** | **Course Objectives** |
| I | Forms, textures and structures of igneous rocks. Petrology and geotectonic evolution of granites, basalts, andesites and alkaline rocks. Petrology of gabbros, kimberlites, anorthosites and carbonatites.Origin of primary basic magmas. Classification of igneous rocks. Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma -mixing, - mingling and -immiscibility. Generation of magmas. Factors affecting their evolution and their relation to plate tectonics– Magmatic differentiation and Assimilation. Variation diagrams. | 12 | CO1 |
| II | Silicate melt equilibria, binary and ternary phase diagrams. Experimental Petrology - Phase equilibrium of binary and ternary silicate systems and its petrological implications – Effect of Pressure on silicate systems – Trace elements in magmatic crystallization – Trace element modelling. Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, alkaline rocks, Kimberlites, ophiolites and granitoids. | 12 | CO2 |
| III | Basic Concepts of Metamorphic Petrology – Types of metamorphism – agents of metamorphism – Zones and grades. Facies concept of metamorphism. Graphical Representation of metamorphic paragenesisPetrogenesis of important metamorphic rocks – charnockite – eclogite – amphibolite – migmatites – Khondalites – metamorphic belts Textures and structures of metamorphic rocks. Regional and contact metamorphism of pelitic and impure calcareous rocks.Mineral assemblages and P/T conditions.Experimental and thermodynamic appraisal of metamorphic reactions.Characteristics of different grades and facies of metamorphism.Metasomatism and granitization, migmatites.Plate tectonics and metamorphic zones.Paired metamorphic belts.Mineral reactions with condensed phases,solid solutions, mixed volatile equilibria and thermobarometry. | 12 | CO2 |
| IV | Earth Surface System: Liberation and flux of sediments, Processes of transport and generation of sedimentary structures, Control on the sedimentary record, Cyclic Sediments, – Classification of sedimentary rocks – Definition, measurements and interpretation of grain size. Evolution of Sedimentary Basins: Classification and definition of Sedimentary basins, Tectonics and Sedimentation – Plate tectonic concepts – Sedimentary basins of India – Paleocurrent and Basin analysis – Provenance and Diagenesis of sediments. | 12 | CO2 |
| V | Sedimentary environments and facies, Continental alluvial – fluvial, lacustrine, desert – Eolian and Glacial sedimentary systems; Shallow Coastal Facies, Marine and Continental Evaporates; Shallow water Carbonates; Deep sea basins; Volcanoclasts Petrography of rocks of Clastic, Chemical and Biochemical origin, Clastic Petrofacies, Paleoclimate and Paleoenvironment analyses; Application of trace elements, Rare-earth elements and Stable isotope geochemistry to sedimentological problems. Depositional environments and systems. Paleocurrent analysis. | 12 | CO2 |
|  | **Text Books** | | |
| 1. | Philpotts, A., 1992, Igneous and Metamorphic Petrology, Prentice Hall. | | |
| 2. | Turner,F.J., 1980, Metamorphic Petrology, McGraw Hill., New York. | | |
| 3. | Best M.G,Igneous Petrology.Wiley.NewDelhi(2005) | | |
| 4. | Hatch,F.H. et al,Petrology of the Igneous Rooks, CBSDelhi. | | |
| 5. | Hyndman D.W, Petrology of the Igneous and Metamorphic Rocks McGrawHill.NewYork(1985) | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | |
| 1. | Bose, M.K., 1997, Igneous Petrology., World Press. | | |
| 2. | Bucher, K and Frey, M., 1994, Petrogenesis of Metamorphic Rocks, Springer – Verlag. | | |
| 3. | Winter,J.D,Principles of Igneous and Metamorphic Petrology, PHI.New | | |
| 4. | Middlemost E.A.K,Magmas and Magmatic Rocks.Longman UK(1985) | | |
| 5. | Winkler,H.G.F, Petrology of the Metamorphic Rocks. Springer,New Delhi(1970) | | |
| **Web Resources** | | | |
| 1. | https://minerva.union.edu/hollochk/c-petrology/resources.html | | |
| 2. | https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html | | |
| 3. | https://geology.com/rocks/igneous-rocks.shtml | | |
| 4. | https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/ | | |
| 5. | https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html | | |

**Course outcome**:

CO1:To gain knowledge about the study of rocks - igneous, metamorphic, and sedimentary - and the processes that form and transform them.

CO2: Students gain on Silicate melt equilibria, binary and ternary phase diagrams.

CO3: students learn about the Basic Concepts of Metamorphic Petrology

CO4: Students learn Definition, measurements and interpretation of grain size

CO5: Students get knowledge on Sedimentary environments and facies

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-II: Environmental Earth Science ( Ist year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | |
| **CIA** | | **External** | **Total** |
|  | **Environmental Earth Science** | Elective | Y | - | - | - | 3 | | 4 | 25 | | 75 | 100 |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To identify knowledge on various types of environmental issues in relation to the Earth as a System | | | | | | | | | | | | |
|  | To explain the various causes of pollution | | | | | | | | | | | | |
|  | To explain the various types of pollution | | | | | | | | | | | | |
|  | To select the remedial measures to be taken as an individual and a group | | | | | | | | | | | | |
|  | Understanding the dynamics of the Earth | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Concept of environment – Environmental monitoring – Water as a resource, Water pollution – Point and non-point pollution sources – Ground water pollution. | | | | | | | 12 | | | CO1 | | |
| II | Air pollution – Natural and anthropogenic sources of air pollution – Primary and secondary air pollutants – Anthropogenic activities and air pollution – Indoor air quality – Biological sources of indoor pollution – Health effects – Air quality standards – Case histories – Air quality monitoring – Acid rain – Adverse effects of acid rain – Health effects – Mitigation measures – Roles and responsibilities. | | | | | | | 12 | | | CO2 | | |
| III | Smog – Mechanism of smog formation – Health disorders – Photochemical smog – Ozone and PAN formation – Health effects – Catalytic converters – Greenhouse gases and effect – Processes of removal of greenhouse gases. | | | | | | | 12 | | | CO2 | | |
| IV | Methods of waste disposal – Landfills – Trash compactors – Incineration – Recycling – Biological processing – Mulch and compost – Energy production – Waste reduction – Waste handling and transport – Waste management – Concept of waste hierarchy – Education and awareness. | | | | | | | 12 | | | CO2 | | |
| V | Medical geology – Problems associated with fluoride, arsenic, asbestos, mercury, chromium, cadmium, zinc,   copper and lead contamination – Alternate energy resources – Climate change. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Fair bridge, R.W. (1972) *Encyclopedia of Geochemistry and Environmental Science*. John Wiley. | | | | | | | | | | | | |
| 2. | Keller, Edward A. (1996) *Environmental Geology*. New Jersey: Prentice-Hall | | | | | | | | | | | | |
| 3. | Coppola D.P, Introduction to International Disaster Management, Butterworth Heinemann(2007) | | | | | | | | | | | | |
| 4. | Pine,J.C, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group(2009) | | | | | | | | | | | | |
| 5. | Smith K, Environmental Hazards: Assessing Risk and Reducing Disaster Rout ledge Press(2001) | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Strahler, A.N. and Strahler, A.H. (1973) *Environmental Geoscience – Interaction between Natural Systems and Man*. Hamilton Publishing Co., Santa Barbara, California. | | | | | | | | | | | | |
| 2. | Kudesia, V.P. (1980) *Water Pollution*. Pragathi Prakasam, Meerut. | | | | | | | | | | | | |
| 3. | Groundwater Assessment Development and Management, Karanth.K.R. (1987) Tata McGraw Hill Publishing Company, Ltd. | | | | | | | | | | | | |
| 4. | Miller T.G. Environmental Science. Wadsworth Publishing.US(2004). | | | | | | | | | | | | |
| 5. | Coates,D.R. Environmental Geology. McGraw Hill.NewYork(1984) | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | https://www.britannica.com/science/geology/sedimentary-petrology | | | | | | | | | | | | |
| 2. | https://limk.springer.com/chapter/10 | | | | | | | | | | | | |
| 3. | https://www.geo.mtu.edu/UPSeis/hazards.html | | | | | | | | | | | | |
| 4. | https://www.omafra.gov.on.ca/english/engineer/facts/ | | | | | | | | | | | | |
| 5. | https://geology.com/rocks/rock-salt.shtml | | | | | | | | | | | | |

**Course Outcome:**

**CO1:** To know the basic knowledge about theClimate: Classification, Global warming and climate change

CO2: Student get knowledge on Pollution Monitoring studies

CO3:Studnets know about the Environmental Healh hazard

CO4: Students learn the Waste management studies

CO5: Student get involved in Medical geology applications

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 3 |
| **CO 2** | 3 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 3 |
| **CO 3** | 3 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 3 |
| **CO 4** | 3 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 3 |
| **CO 5** | 3 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**SEMESTER-II: Personality Development ( Ist Year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Personality Development** | Soft Skill2 | Y | - | - | - | 2 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | The student can List, Identify and Define different habits of highly effective Teenager | | | | | | | | | | | | |
|  | Describe and explain his/her own habits that make them to grow or destroy | | | | | | | | | | | | |
|  | Select different habits that can make them to grow successfully | | | | | | | | | | | | |
|  | Can differentiate and evaluate different habits that make them effective teenager | | | | | | | | | | | | |
|  | Conceive the idea to become an effective teenager | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | The concept of personality - Dimensions of Personality – Theories of Personality Development - Importance of Personality Development. Self Awareness – Meaning – Benefits of Self – Awareness – Developing Self – Awareness. | | | | | | | 12 | | | CO1 | | |
| II | Human Growth and Development: Pregnancy and childbirth – infancy – babyhood – childhood – adolescent – adulthood – middle age – old age. | | | | | | | 12 | | | CO2 | | |
| III | Attitude – Concept, Significance, Factors affecting attitudes, Positive attitude, Negative attitude - Differences between personalities having positive and negative attitude - Motivation– Concept, Internal and external motives - Importance of self- motivation. | | | | | | | 12 | | | CO2 | | |
| IV | SWOT Analysis – Meaning, Applications and Components -Transactional Analysis – Meaning, EGO States - Johari Window - Emotional Intelligence – Meaning, Components and Significance - Stress Management – Meaning, Sources of Stress, Consequences of Stress, Managing Stress. | | | | | | | 12 | | | CO2 | | |
| V | Communication – Definition, Process, Communication Symbols, Communication network, Barriers in communication - - Decision-making skills - Leadership – Definition, Leadership style, Qualities of an Effect leader – Team Building – Meaning, Types of teams, Importance of Team building – Negotiation Skills – Meaning, Principles of Negotiation, Types of Negotiation - Conflict Management – Definition, Types of Conflict, Conflict Resolution. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Davidoff.L.L: Introduction to psychology, Aucklan; McGraw hill Inc 1881. | | | | | | | | | | | | |
| 2. | Hurlock E.B Development psychology, Tata mc Graw Hill,5th Ed.,1971, New Delhi. | | | | | | | | | | | | |
| 3. | Rothbart MK, Ahadi SA, Evans DE (2000). "Temperament and personality: Origins and outcomes". Journal of Personality and Social Psychology. 78 (1): 122–135. [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1037/0022-3514.78.1.122](https://doi.org/10.1037%2F0022-3514.78.1.122). [PMID](https://en.wikipedia.org/wiki/PMID_(identifier)) [10653510](https://pubmed.ncbi.nlm.nih.gov/10653510) | | | | | | | | | | | | |
| 4. | Bell, M. G. (2010, January 1). Consciousness: The Evolution Of The Self And Personal Individuality. Retrieved November 1, 2014 | | | | | | | | | | | | |
| 5. | eal JE, Halverson CF, Havill V, Martin R (2005). "Temperament factors as longitudinal predictors of young adult personality". Merrill-Palmer Quarterly. 51 (3): 315–334. [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1353/mpq.2005.0015](https://doi.org/10.1353%2Fmpq.2005.0015). [S2CID](https://en.wikipedia.org/wiki/S2CID_(identifier)) [143953664](https://api.semanticscholar.org/CorpusID:143953664) | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Stephan P.Robbins, Organisational Behaviour, Tenth Edition, Prentice Hall of India Private Limited, New Delhi,2008 | | | | | | | | | | | | |
| 2. | Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005. | | | | | | | | | | | | |
| 3. | Caspi A, Roberts BW (2001). "Personality development across the life course: The argument for change and continuity". Psychological Inquiry. 12 (2): 49–66. [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1207/s15327965pli1202\_01](https://doi.org/10.1207%2Fs15327965pli1202_01). [S2CID](https://en.wikipedia.org/wiki/S2CID_(identifier)) [144947217](https://api.semanticscholar.org/CorpusID:144947217). | | | | | | | | | | | | |
| 4. | Roberts, B. W., Wood, D., & Caspi, A. (2010). The development of personality traits in adulthood. In O. P. John, R. W. Robins, & L. A. Pervi (Eds.), Handbook of personality: Theory and research (3rd ed., pp. 375-398). New York, NY: Guilford Press. | | | | | | | | | | | | |
| 5. | Wrzus, Cornelia (2021), ["Processes of personality development: An update of the TESSERA framework"](https://dx.doi.org/10.1016/b978-0-12-813995-0.00005-4), The Handbook of Personality Dynamics and Processes, Elsevier, pp. 101–123, [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1016/b978-0-12-813995-0.00005-4](https://doi.org/10.1016%2Fb978-0-12-813995-0.00005-4), [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [9780128139950](https://en.wikipedia.org/wiki/Special:BookSources/9780128139950), [S2CID](https://en.wikipedia.org/wiki/S2CID_(identifier)) [234237414](https://api.semanticscholar.org/CorpusID:234237414) | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | <https://learn.financestrategists.com/finance-terms/b2b/?gclid=Cj0KCQiAtvSdBhD0ARIsAPf8oNlxuLojiIVK22uBm_Xbs6BZFpqDTzXKjD74Tj-6jCzwpQxrvZ3KnngaAirDEALw_wcB> | | | | | | | | | | | | |
| 2. | <https://www.metmuseum.org/toah/hd/sasa/hd_sasa.htm> | | | | | | | | | | | | |
| 3. | <https://www.linkedin.com/pulse/7-lessons-from-islam-personal-development-shazma-ahmed> | | | | | | | | | | | | |
| 4. | <https://irsc.libguides.com/c.php?g=808755&p=5772790> | | | | | | | | | | | | |
| 5. | <https://www.atlantis-press.com/proceedings/icadce-18/25900154> | | | | | | | | | | | | |

**Course Outcome:**

CO1:The student will be able to understand, analyse develop and exhibit accurate sense of self..

CO2: Student learn the Human Growth and Development

CO3: Get knowledge on Importance of self- motivation

CO4: Student can understand the SWOT Analysis

CO5: Communication – Definition, Process, Communication Symbols, Communication network

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-III: Geophysics ( IInd year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Geophysics** | Core | Y | - | - | - | 4 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | Student will able to apply geophysical methods for exploring hidden ore minerals, ground water, oil and natural gas resources. | | | | | | | | | | | | |
|  | Explain the principles behind different geophysical surveying techniques. | | | | | | | | | | | | |
|  | Process, analyze and interpret gravitational, magnetic and electromagnetic surveying data. | | | | | | | | | | | | |
|  | Understand the earth subsurface using electrical resistivity. | | | | | | | | | | | | |
|  | Describes the subsurface of the Earth in physical terms – density, electrical resistivity, magnetism, conductivity, and heat flow. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Introduction – Physical basis of geophysical exploration, various surface and sub-surface methods and their classification. Physical properties of rocks and minerals exploited in exploration and factors that control them. Geophysical anomaly, Radioactivity of rocks and ores, radioactive minerals and ores. Radiation measuring devices – Ionization chambers, gas filled (Geiger Mϋller) counters, scintillation counters, radiometers and γ ray spectrometers. Field radiometric methods – Air-borne surveys, automobile surveys, foot surveys.Processing and interpretation of field data.Application of radiometric methods. | | | | | | | 12 | | | CO1 | | |
| II | Gravity Prospecting: Gravity prospecting – Principles, the Earth’s gravitational field and units, its variation, Newton’s Law – Geoid, spheroid and normal gravity field, figure of earth. Order of anomalies produced by geological discontinuities, absolute and relative measurement of gravity, gravimeters and their operation in the field. Field procedure, reduction and correction of gravity field data, separation of regional and residuals, upward and downward continuation, interpretation of gravity data obtained over spherical and cylindrical objects, sheet, dike and faults – Applications of gravity methods. | | | | | | | 12 | | | CO2 | | |
| III | Electrical methods – Electrical properties of earth materials – Conduction in rocks, conduction in water-bearing rocks, description of geoelectric sections, classification of electrical methods. Resistivity method – Ohm’s Law, resistivity, factors affecting resistivity, effect of homogenous earth, various configurations for resistivity methods, configuration factor, response over a layered earth. AC and DC type resistivity meters, field procedure for electrical profiling and sounding, logarithmic curve matching, advantages of plotting the data on a logarithmic graph paper. Interpretation of profiling and sounding field data, use of modelling in electrical methods, introduction to self-potential, induced polarization methods. | | | | | | | 12 | | | CO2 | | |
| IV | Seismic methods – Fundamentals of elasticity – Young’s modulus, Bulk modulus, Poisson’s ratio, elastic waves, laws of reflection and refraction, Huygen’s principle, Fermat’s principle, Principle of superposition, Seismic wave theory – Helmhotz’s theorem and seismic wave propagation – Body and surface waves – Primary, Secondary, Rayleigh and Love waves – Seismic energy sources – Detectors – Seismic noises and noise profile analysis – Reduction to a datum and weathering corrections - Short period, long period, broad band and strong motion – Seismic instruments – Seismic channel – Details of geophones – Filters, Amplifier and reproducible and non-reproducible recording – Seismic timer field layout – Arc shooting – Fan shooting – Profile shooting | | | | | | | 12 | | | CO2 | | |
| V | Data processing – Corrections applied to seismic field data , Simple interpretation of field data – Seismic refraction and reflection data processing – Applications. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Keller, G.V. and Frischknecht, F.C. (1982) Electrical Methods inGeophysical Prospecting. Pergamon Press, New York. | | | | | | | | | | | | |
| 2. | Rama Rao, B.S. and Murthy, I.V.R. (1978) Gravity and Magnetic Methods of Prospecting. Arnold Heinemann Publishers, New Delhi | | | | | | | | | | | | |
| 3. | Davies, Geoffrey F. (2001). Dynamic Earth: Plates, Plumes and Mantle Convection. [Cambridge University Press](https://en.wikipedia.org/wiki/Cambridge_University_Press). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-521-59067-1](https://en.wikipedia.org/wiki/Special:BookSources/0-521-59067-1). | | | | | | | | | | | | |
| 4. | Bozorgnia, Yousef; Bertero, Vitelmo V. (2004). Earthquake Engineering: From Engineering Seismology to Performance-Based Engineering. [CRC Press](https://en.wikipedia.org/wiki/CRC_Press). | | | | | | | | | | | | |
| 5. | Pedlosky, Joseph (1987). [Geophysical Fluid Dynamics](https://archive.org/details/geophysicalfluid00jose) (Second ed.). [Springer-Verlag](https://en.wikipedia.org/wiki/Springer-Verlag). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-387-96387-1](https://en.wikipedia.org/wiki/Special:BookSources/0-387-96387-1). | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Dobrin, M.B. (1984) An Introduction to Geophysical Prospecting. McGraw-Hill, New Delhi. | | | | | | | | | | | | |
| 2. | Telford, W.M., Geldart, L.P., Sheriff, R.E. and Keys, D.A. (1976) Applied Geophysics. Oxford-IBH Publishing Co. Pvt. Ltd., New Delhi | | | | | | | | | | | | |
| 3. | Hardy, Shaun J.; Goodman, Roy E. (2005). ["Web resources in the history of geophysics"](https://web.archive.org/web/20130427182807/http:/history.agu.org/hgc_web_resources.htm). [American Geophysical Union](https://en.wikipedia.org/wiki/American_Geophysical_Union). Archived from [the original](http://history.agu.org/hgc_web_resources.htm) on 27 April 2013. Retrieved 30 September 2011. | | | | | | | | | | | | |
| 4. | Kivelson, Margaret G.; Russell, Christopher T. (1995). Introduction to Space Physics. [Cambridge University Press](https://en.wikipedia.org/wiki/Cambridge_University_Press). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-0-521-45714-9](https://en.wikipedia.org/wiki/Special:BookSources/978-0-521-45714-9). | | | | | | | | | | | | |
| 5. | Lowrie, William (2004). Fundamentals of Geophysics. [Cambridge University Press](https://en.wikipedia.org/wiki/Cambridge_University_Press). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-521-46164-2](https://en.wikipedia.org/wiki/Special:BookSources/0-521-46164-2) | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | <https://iugg.org/associations-commissions/commissions/sedi/> | | | | | | | | | | | | |
| 2. | <https://iugg.org/> | | | | | | | | | | | | |
| 3. | <https://www.usgs.gov/programs/geomagnetism> | | | | | | | | | | | | |
| 4. | <https://www.udemy.com/course/learn-seismic-data-processing/> | | | | | | | | | | | | |
| 5. | <https://seg.org/Default.aspx?TabId=176&language=en-US> | | | | | | | | | | | | |

**Course Outcome:**

**CO1:** Student can learn in detail about the Gravity and gravity anomalies, gravity survey, gravity map preparation

CO2: Magnetic fields, magnetic behavior of rocks, magnetic methods – anomalies, preparation of magtnetic anomaly maps

CO3: Thermal and electrical properties of rocks, resistivity method

CO4: Application of electrical method in groundwater exploration

CO5 Seismic method, wave propagation principles, seismic data interpretation.

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-III: Hydrogeology ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | | **Hydrogeology** | Core | Y | - | - | - | 4 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | | |
|  | To define different terms and parameters involved in Hydrogeology | | | | | | | | | | | | | |
|  | To enumerate the concept and to interpret the processes involved in groundwater | | | | | | | | | | | | | |
|  | To describe the importance of groundwater and summarise the occurrence of groundwater | | | | | | | | | | | | | |
|  | To interpret the conditions of water resources and to select some areas where the groundwater is being exploited against the natural laws | | | | | | | | | | | | | |
|  | To crtitically assess different factors/aspects involve | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | **Introduction to Hydrogeology:**  Water on Earth - Types of water - Distribution of water - Hydrological cycle and its components: precipitation, evaporation, evapotranspiration, infiltration, surface runoff and sub-surface distribution and movement of ground water and their estimation for the purpose of assessing water availability. Water-bearing properties of rock formations: aquifer- isotropic and anistropic, porosity, permeability, compressibility of rocks. | | | | | | | | 12 | | | CO1 | | |
| II | **Occurrence and movement of Groundwater:** Vertical distribution of groundwater: zone of aeration and zone of saturation – Geological formations as aquifers – Springs - Darcy’s experiment and its limitations, fluid pressure, hydraulic conductivity, transmissitivity – Reynolds Number - Barometric and tidal efficiency of aquifers – Ground water flow- Groundwater flow direction –Unsaturated flow –Steady and unsteady state flow. | | | | | | | | 12 | | | CO2 | | |
| III | **Water wells:** Types of wells - Well hydraulics – Cone of depression, radius of influence, drawdown and specific capacity - Drilling of shallow wells and deep wells – Well Completion – Well development – Testing wells for yield- Protection and rehabilitation of well- Collector wells and Infiltration galleries - Tracer tests and slug tests - Ground water budgeting – Ground water levels and water level maps – Safe yield and Conjunctive uses – Artificial recharge and methods. | | | | | | | | 12 | | | CO2 | | |
| IV | **Groundwater Quality and Pollution:** Chemical constituents in groundwater: sources and effects - Quality criteria for different uses -Geochemical cycle of surface water and ground water- Graphical presentation of groundwater quality data- Dissolved gases in groundwater- Impact of solar energy on groundwater – Sources and causes for pollution of groundwater – Pollution attenuation – Treatment for contaminated groundwater. | | | | | | | | 12 | | | CO2 | | |
| V | **Exploration techniques and Saline water intrusion :** Methods for exploration of ground water – Geological methods, Remote Sensing techniques, geomorphological inputs, gravity, magnetic, seismic and electrical methods – Basics of ground water modeling – Physical, analog and mathematical models, finite difference modeling –Hydrogeology of arid zones of India – Hydrogeology of wetlands. Hydrodynamic equilibrium of fresh and saline water – Ghyben-Herzberg relation- Control of saline water intrusion. | | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | | |
| 1. | Freeze, R.A. and Cherry, J.A. (1979) *Groundwater*. Prentice-Hall. London. | | | | | | | | | | | | | |
| 2. | Fetter, C. W. (2018). *Applied Hydrogeology*.Waveland Press. ISBN: 9781478637448. 4th Edition. E-Book. | | | | | | | | | | | | | |
| 3. | De Marsily, G., 1986. Quantitative Hydrogeology: Groundwater Hydrology for Engineers, Academic Press, Inc., Orlando Florida. — Classic book intended for engineers with mathematical background but it can be read by hydrologists and geologists as well. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-12-208916-2](https://en.wikipedia.org/wiki/Special:BookSources/0-12-208916-2) | | | | | | | | | | | | | |
| 4. | LaMoreaux, Philip E.; Tanner, Judy T, eds. (2001), [Springs and bottled water of the world: Ancient history, source, occurrence, quality and use](https://books.google.com/books?id=sjEoBmfUka0C), Berlin, Heidelberg, New York: Springer-Verlag, [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [3-540-61841-4](https://en.wikipedia.org/wiki/Special:BookSources/3-540-61841-4) Good, accessible overview of hydrogeological processes. | | | | | | | | | | | | | |
| 5. | Porges, Robert E. & Hammer, Matthew J., 2001. The Compendium of Hydrogeology, National Ground Water Association, [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [1-56034-100-9](https://en.wikipedia.org/wiki/Special:BookSources/1-56034-100-9). Written by practicing hydrogeologists, this inclusive handbook provides a concise, easy-to-use reference for hydrologic terms, equations, pertinent physical parameters, and acronyms | | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | | |
| 1. | Todd, D.K. and Mays, L.W. (2013)*Groundwater Hydrology*.John Wiley & Sons, New York. ISBN: 978-81-265-3003-8. 3rd Edition. | | | | | | | | | | | | | |
| 2. | Davis and DeWeist. (1966).*Geohydrology*. John Wiley & Sons, New York. | | | | | | | | | | | | | |
| 3. | Domenico, P.A. & Schwartz, W., 1998. Physical and Chemical Hydrogeology Second Edition, Wiley. — Good book for consultants, it has many real-world examples and covers additional topics (e.g. heat flow, multi-phase and unsaturated flow). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-471-59762-7](https://en.wikipedia.org/wiki/Special:BookSources/0-471-59762-7) | | | | | | | | | | | | | |
| 4. | Driscoll, Fletcher, 1986. Groundwater and Wells, US Filter / Johnson Screens. — Practical book illustrating the actual process of drilling, developing and utilizing water wells, but it is a trade book, so some of the material is slanted towards the products made by Johnson Well Screens. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-9616456-0-1](https://en.wikipedia.org/wiki/Special:BookSources/0-9616456-0-1) | | | | | | | | | | | | | |
| 5. | [Anderson, Mary P.](https://en.wikipedia.org/wiki/Mary_P._Anderson) & Woessner, William W., 1992 Applied Groundwater Modeling, Academic Press. — An introduction to groundwater modeling, a little bit old, but the methods are still very applicable. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-12-059485-4](https://en.wikipedia.org/wiki/Special:BookSources/0-12-059485-4) | | | | | | | | | | | | | |

|  |  |
| --- | --- |
| **Web Resources** | |
| 1. | <https://iah.org/> |
| 2. | <http://www.groundwateruk.org/> |
| 3. | <https://gw-project.org/books/groundwater-resource-development>. |
| 4. | <https://www.epa.gov/dwreginfo/drinking-water-regulations>. |
| 5. | [https://www.guidelinegeo.com/groundwater-prospection](https://www.guidelinegeo.com/groundwater-prospection/?gclid=Cj0KCQiAtvSdBhD0ARIsAPf8oNlyfPUSPrLywwkkNTuTRqMMsoCbCXXjUyqvspn2XCtSEyhBR7Yc_18aApe1EALw_wcB) |

**Course Outcome:**

CO1: This study helps to understand the Hydrological cycle, Aquifer; flow rates and flow directions , Groundwater fluctuation: types, controlling factors

CO2: Occurrence and movement of Groundwater

CO3: Groundwater wells, types and methods

CO4: Groundwater chemistry: Components of groundwater Groundwater pollution: Arsenic, fluoride and Nitrate

CO5 Salinity in Groundwater , Seawater intrusion and Ghyben-Herzberg Relation

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 2 |
| **CO 2** | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-III: Geophysics and Applied Hydrogeology Practical ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Geophysics and Applied Hydrogeology Practical** | Core | Y | - | - | - | 4 | | 4 | 40 | | 60 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To identify the groundwater potential zone | | | | | | | | | | | | |
|  | To describe the different geophysical methods | | | | | | | | | | | | |
|  | Understand how groundwater infiltrates and flows through Earth materials | | | | | | | | | | | | |
|  | To interpret groundwater flow direction from the topographic features | | | | | | | | | | | | |
|  | To critically assess the quality of groundwater | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | **Electrical Resistivity methods**: Interpretation of vertical electrical sounding data obtained over 2- and 3-layered earth using the S-line, curve matching and auxiliary point chart method – Field demonstration of resistivity, seismic SP and magnetic prospecting techniques.  . | | | | | | | 12 | | | CO1 | | |
| II | **Gravity Methods:** Computation of gravity response over a sphere – Exercises on drift correction, separation of regional and residual of gravity data – Contouring of gravity data – Calibration of magnetometer – Interpretation of field magnetic data over a dike. Interpretation of seismic refraction data obtained over 2- and 3-layered earth – Computation of configuration constant. | | | | | | | 12 | | | CO2 | | |
| III | **Aquifers and Aquitards:**Factors affecting infiltration and ground water flow: Porosity – Permeability - Grain size – Specific yield – Specific retention – Hazen method for Hydraulic conductivity - Storativity | | | | | | | 12 | | | CO2 | | |
| IV | **Groundwater flow:**  Specific discharge – Average linear velocity – Flow net – Flow across water table –Steady unidirectional flow – Unsteady radial flow. | | | | | | | 12 | | | CO2 | | |
| V | **Water chemistry: S**olubility –Ionic strength of groundwater - Trilinear diagram – Oxidation potential *Eh.* **Laboratory –** Uses of Multiparameter – On field water parameter analysis techniques – Preparation of standards for analysis. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Freeze, R.A. and Cherry, J.A. (1979) *Groundwater*. Prentice-Hall. London. | | | | | | | | | | | | |
| 2. | Fetter, C. W. (2018). *Applied Hydrogeology*.Waveland Press. ISBN: 9781478637448. 4th Edition. E-Book. | | | | | | | | | | | | |
| 3. | De Marsily, G., 1986. Quantitative Hydrogeology: Groundwater Hydrology for Engineers, Academic Press, Inc., Orlando Florida. — Classic book intended for engineers with mathematical background but it can be read by hydrologists and geologists as well. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-12-208916-2](https://en.wikipedia.org/wiki/Special:BookSources/0-12-208916-2) | | | | | | | | | | | | |
| 4. | LaMoreaux, Philip E.; Tanner, Judy T, eds. (2001), [Springs and bottled water of the world: Ancient history, source, occurrence, quality and use](https://books.google.com/books?id=sjEoBmfUka0C), Berlin, Heidelberg, New York: Springer-Verlag, [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [3-540-61841-4](https://en.wikipedia.org/wiki/Special:BookSources/3-540-61841-4) Good, accessible overview of hydrogeological processes. | | | | | | | | | | | | |
| 5. | Porges, Robert E. & Hammer, Matthew J., 2001. The Compendium of Hydrogeology, National Ground Water Association, [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [1-56034-100-9](https://en.wikipedia.org/wiki/Special:BookSources/1-56034-100-9). Written by practicing hydrogeologists, this inclusive handbook provides a concise, easy-to-use reference for hydrologic terms, equations, pertinent physical parameters, and acronyms | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Todd, D.K. and Mays, L.W. (2013)*Groundwater Hydrology*.John Wiley & Sons, New York. ISBN: 978-81-265-3003-8. 3rd Edition. | | | | | | | | | | | | |
| 2. | Davis and DeWeist. (1966).*Geohydrology*. John Wiley & Sons, New York. | | | | | | | | | | | | |
| 3. | Domenico, P.A. & Schwartz, W., 1998. Physical and Chemical Hydrogeology Second Edition, Wiley. — Good book for consultants, it has many real-world examples and covers additional topics (e.g. heat flow, multi-phase and unsaturated flow). [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-471-59762-7](https://en.wikipedia.org/wiki/Special:BookSources/0-471-59762-7) | | | | | | | | | | | | |
| 4. | Driscoll, Fletcher, 1986. Groundwater and Wells, US Filter / Johnson Screens. — Practical book illustrating the actual process of drilling, developing and utilizing water wells, but it is a trade book, so some of the material is slanted towards the products made by Johnson Well Screens. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-9616456-0-1](https://en.wikipedia.org/wiki/Special:BookSources/0-9616456-0-1) | | | | | | | | | | | | |
| 5. | [Anderson, Mary P.](https://en.wikipedia.org/wiki/Mary_P._Anderson) & Woessner, William W., 1992 Applied Groundwater Modeling, Academic Press. — An introduction to groundwater modeling, a little bit old, but the methods are still very applicable. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [0-12-059485-4](https://en.wikipedia.org/wiki/Special:BookSources/0-12-059485-4) | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | <https://iah.org/> | | | | | | | | | | | | |
| 2. | <https://gw-project.org/books/groundwater-resource-development/> | | | | | | | | | | | | |
| 3. | <https://info.aquaclara.org/what-are-the-most-common-water-contaminants> | | | | | | | | | | | | |
| 4. | <https://www.usgs.gov/mission-areas/water-resources> | | | | | | | | | | | | |

**Course Outcome:**

CO1: The student will be able to understand the **Electrical Resistivity methods**

CO2: Understand the application of near surface geophysical techniques for aquifer characterization.

CO3: Student gain knowledge on Groundwater flow

CO4: student get knowledge on Aquifers and Aquitards studies

CO5: Student learn about the Water chemistry

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |
| **CO 5** | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-III: Economic and Industrial Geology ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Economic Geology** | Elective | Y | - | - | - | 3 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To provide knowledge on economically relevant minerals and metals | | | | | | | | | | | | |
|  | To explain the Ore genesis responsible for the economic deposits | | | | | | | | | | | | |
|  | To provide practical knowledge on the minerals and metals | | | | | | | | | | | | |
|  | Detail on the methods applied for mineral exploration | | | | | | | | | | | | |
|  | To summarise the radioactive mineral deposits | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | **Ore Genesis**. Ore deposits and ore minerals. Magmatic processes of mineralization. Porphyry, skarn and hydrothermal mineralization. Fluid inclusion studies, sedimentary, supergene enrichment, placer. Mineralisation associated with – (i) ultramafic, mafic and acidic rocks (ii) greenstone belts (iii) komatiites, anorthosites and kimberlites and (iv) submarine volcanism. Magma related mineralization through geological time. Stratiform and stratabound ores. Ores and metamorphism – cause and effect relations. Metallogeny and mineral belts. SedEx deposits. | | | | | | | 12 | | | CO1 | | |
| II | **Mineral Exploration**. Principles of mineral prospecting and exploration - conceptualization, methodology and stages; sampling, subsurface sampling including pitting, trenching and drilling, core and non-core drilling, planning of bore holes and location of bore holes on ground. Core logging, geochemical exploration- nature of samples anomaly, strength of anomaly and controlling factors, coefficient of aqueous migration. | | | | | | | 12 | | | CO2 | | |
| III | Mineralogy and geochemistry of radioactive minerals.Origin and Mineralogy and geochemistry of radioactive minerals.Instrumental techniques of detection and measurement of radioactivity.Radioactive methods for prospecting and assaying of mineral deposits. Distribution of radioactive minerals in India. Radioactive methods in petroleum exploration — well logging techniques. Nuclear waste disposal — geological constraints. | | | | | | | 12 | | | CO2 | | |
| IV | **Coal and petroleum Geology**. Coal and its properties: Different varieties and ranks of coal. Origin of coal. Coalification process and its causes. Fundamentals of coal petrology. Origin, migration and entrapment of natural hydrocarbons. Characters of source and reservoir rocks. Structural, stratigraphic and mixed traps. Techniques of exploration. Structural, stratigraphic and mixed traps. Techniques of exploration. Methods of petroleum exploration. Petroliferous basins of India. | | | | | | | 12 | | | CO2 | | |
| V | **Industrial Geology**. Identification and description of ore and industrial minerals. Geological studies in Coal industries; Petroleum industries; Geological investigation in mining industries. Need of Geologist in industrial sectors. Role of geologist in NLC, ONGC, GSI, WIHG, NIO, NGRI, PRL, RRL, Soil Survey of India, BSIP, Archaeological survey of India. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Banerjee, P. K. and Ghosh, S. (1997) Elements of Prospecting for Non-Fuel Mineral Deposits. Allied Publishers Ltd., New Delhi. | | | | | | | | | | | | |
| 2. | Chatterjee, K. K. (1993) An Introduction to Mineral Economics. Wiley Eastern Ltd., New Delhi. | | | | | | | | | | | | |
| 3. | Krishnasamy S, India’s Mineral Resources, Oxford & IBH. Delhi(1988) | | | | | | | | | | | | |
| 4. | Sharma N.L&R.K.Sinha. Mineral Economics, Oxford & IBH. Delhi(1985) | | | | | | | | | | | | |
| 5. | Prasad U, Economic Mineral Deposits, CBS. Delhi (2003) | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Krishnaswamy, S. (1979) India’s Mineral Resources. Oxford-IBH Publishers, New Delhi. | | | | | | | | | | | | |
| 2. | Bateman, A. M. and Jensen, M. L. (1981) Economic Mineral Deposits. John Wiley & Sons, New York | | | | | | | | | | | | |
| 3. | Industrial Minerals , Sinha,R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi. | | | | | | | | | | | | |
| 4. | Craig,R.C& D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York.(1985) | | | | | | | | | | | | |
| 5. | Aiyengar, N.K.N, Minerals of Madras, Dept.of Industries &Commerce. Guindy, Madras, (1964). | | | | | | | | | | | | |

|  |  |
| --- | --- |
| **Web Resources** | |
| 1. | https://www.britannica.com/topic/economic-geology |
| 2. | https://en.m.wikipedia.org/wiki/supergene-(geology) |
| 3. | https://energymining.sa.gov.au/minerals/mineral-commodities |
| 4. | https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology |
| 5. | https://link.spring.com/ |

**Course outcome:**

CO1: Students will have the knowledge and skills to recognise common ore minerals in hand samples and under the microscope.

CO2: Demonstrate familiarity with a wide range of mineral deposits, including recognising the overall geometry, zonation and alteration patterns associated with specific classes of metallic mineral deposits,

CO3: To get awareness on geochemistry of radioactive minerals

CO4: Fundamentals of coal petrology, Gain knowledge on the Origin, migration and entrapment of natural hydrocarbons

CO5: Student learns more knowledge on industrial aspects in geological studies.

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-III: Disaster Management ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Disaster Management** | Elective | Y | - | - | - | 3 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | Understand the basics of natural hazards, distinguish hazards and disasters, global trends, vulnerable communities, importance of inter-disciplinary studies. | | | | | | | | | | | | |
|  | Students will comprehend the core part of disaster management i.e. geotechnical aspect, community aspect and environmental aspect and its inter-linkages | | | | | | | | | | | | |
|  | Comprehend the complexity of climate change induced disasters, mapping and monitoring techniques including risk zonation and appropriate technology tools for mitigation. | | | | | | | | | | | | |
|  | Acquiring knowledge on community-based disaster management, disaster risk reduction (DRR), community resilience and the importance of hazard mapping. | | | | | | | | | | | | |
|  | Evaluate the importance of this inter-disciplinary course through case study experiences and to use these skills in the real-world scenario | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | General introduction to natural hazards and disasters: Physical and geodynamic characteristics of earthquakes, tsunamis and storm surges, tropical cyclones, monsoonal floods, landslides. Droughts - different types – monitoring and management and wildfires – Worldwide trends in natural catastrophes and occurrence. | | | | | | | 12 | | | CO1 | | |
| II | Global Climate Change: Global warming and environmental change – Threat of sea level changes on global coasts - Impact on natural resources, environment – Social impact of disasters – Gender, food security, poverty and Climate Change Adaptation. | | | | | | | 12 | | | CO2 | | |
| III | Assessment: Hazard-prone areas identification – Application of remote sensing and GIS tools – Hazard mapping – Risk modeling – Risk zonation and case studies. | | | | | | | 12 | | | CO2 | | |
| IV | Preparedness: Risk reduction concepts – Pre- and post-disaster comparison and analysis – Understanding the disaster cycle – Stakeholders’ participation and preparation of comprehensive management plans – Community-based disaster risk management – Participatory risk assessment – Coastal regulations – Coastal management in tsunami reconstruction – National and international scenarios. | | | | | | | 12 | | | CO2 | | |
| V | Mitigation and recovery: Inter-relationship between mitigation and recovery – Process for developing hazards mitigation plan, implementation of comprehensive mitigation strategies – Disaster recovery planning – Disaster emergency preparedness and on recovery and reconstruction – Disaster Risk Reduction (DRR) approaches - Early warning systems. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Handbook of Disaster Research Eds. H. Rodriguez et al., (2006). | | | | | | | | | | | | |
| 2. | Rajib Shaw and Krishnamurthy, R.R. (2008) Disaster Management – The Global Challenges and Local Solutions, Universities Press, Hyderabad, pp. 560. | | | | | | | | | | | | |
| 3. | Groundwater Assessment Development and Management, Karanth.K.R. (1987) Tata McGraw Hill Publishing Company, Ltd. | | | | | | | | | | | | |
| 4. | Miller T.G. Environmental Science. Wadsworth Publishing.US(2004). | | | | | | | | | | | | |
| 5. | Coates,D.R. Environmental Geology. McGraw Hill.NewYork(1984) | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Shaw, R. and Rouhban, B. (2005) Disaster Reduction and Human Security. UNESCO & Kyoto University. | | | | | | | | | | | | |
| 2. | Babar, Md. (Ed.) (2007) Environmental Changes and Natural Disasters. New Delhi Publishing Agency. | | | | | | | | | | | | |
| 3. | Coppola D.P, Introduction to International Disaster Management, Butterworth Heinemann(2007) | | | | | | | | | | | | |
| 4. | Pine,J.C, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group(2009) | | | | | | | | | | | | |
| 5. | Smith K, Environmental Hazards: Assessing Risk and Reducing Disaster Rout ledge Press(2001) | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | https://www.britannica.com/science/geology/sedimentary-petrology | | | | | | | | | | | | |
| 2. | https://limk.springer.com/chapter/10 | | | | | | | | | | | | |
| 3. | https://www.geo.mtu.edu/UPSeis/hazards.html | | | | | | | | | | | | |
| 4. | https://www.omafra.gov.on.ca/english/engineer/facts/ | | | | | | | | | | | | |
| 5. | https://geology.com/rocks/rock-salt.shtml | | | | | | | | | | | | |

**Course Outcome:**CO1: Understand the need and significance of studying disaster management

CO2: Understand the different types of disasters and causes for disasters.

CO3: Gain knowledge on the impacts Disasters on environment and society

CO4: Study and assess vulnerability of a geographical area.

CO5: Students will be equipped with various methods of risk reduction measures and risk mitigation

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**SEMESTER-III: INTERNSHIP ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **INTERNSHIP** | Core | Y | - | - | - | 2 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | The students will enhance their writing skills. | | | | | | | | | | | | |
|  | They will acquire knowledge about writing their assignments. | | | | | | | | | | | | |
|  | They will delve into unchartered territory with regard to Scientific/Technical writing of research papers/reports. | | | | | | | | | | | | |
|  | The students will understand what is Bibliography, how to cite references and how to quote them in the text. | | | | | | | | | | | | |
|  | They will be trained in how to avoid redundancies, which constitute a major problem while writing a Scientific Paper/Technical Report. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | THE PRE-WRITING STAGE: Why Write?-What is a Scientific Paper?-What is a Technical Report? PLANNING THE SCIENTIFIC PAPER OR REPORT: Structure-Headings-Note for Framework-Format-Keeping a Card Index-Assembling the Data. CONTENTS OF SCIENTIFIC PAPERS; The Parts of a Scientific Paper-Preliminaries-Text-End Material | | | | | | | 12 | | | CO1 | | |
| II | CONTENTS OF TECHNICAL REPORTS: Types of Reports-Investigations-Proposals-Progress Reports-Information-Feasibility Study-Alternative Order. ILLUSTRATIONS AND TABLES: Maps-Line Drawings-Graphs-Photographs-Current Practices on Illustrations-tables. | | | | | | | 12 | | | CO2 | | |
| III | STYLE AND FORM: Accuracy of Content-Clarity and simplicity of Expression-Coherence-Conciseness-Logical Sequence. AIDS TO WRITING: Grammar and Usage-Abbreviations-Compounding of words-Placement of Phrases- Italics-Numerical Expressions-Units and Symbols-Punctuation-Spelling-Conclusion. | | | | | | | 12 | | | CO2 | | |
| IV | WRITING PRACTICES: Rewriting-Readability-Checklist-Preparation of Final Manuscript. ON PROOF READING: Proof reading Requirements-Proof Reading Symbols- Modern Methods of MS Preparation. ABOUT PUBLISHING: Procedures-Double Publishing-Authorship-Copyright- Cataloguing- Guarantees-Reproduction of Published Material-Royalty-Conference Proceeding. | | | | | | | 12 | | | CO2 | | |
| V | REFREES, FORMATS AND PROOFS: Duties of a Referee- Standard Format Requirements-Editing of Proofs. ORAL AND POSTER PRESENTATIONS: Preamble-Mode of Oral Presentation-Aids to Oral Presentation-Poster Presentation. PROJECT PROPOSALS: Types of Project Proposals- The Strategy Project Proposals-Some formats of Project Proposals- Project Proposal Evaluation- Examples of Evaluations. | | | | | | | 12 | | | CO2 | | |
|  |  | | | | | | | | | | | | |
| 1. | Whitesides, G. Writing a Scientific Paper Full text. Originally presented at the 231st National Meeting of the American Chemical Society (ACS) in Atlanta, GA, March 26-30, 2006. Division of Chemical Information, CINF 17. | | | | | | | | | | | | |
| 2. | The Science of Scientific Writing Full textan article by George Gopen and Judith Swan, published in American Scientist, Vol. 78, No. 6 (November-December 1990), pp. 550-558. | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Guide to Scientific and Technical Writing - P. G. Cooray 1992. ISBN - 9559543407, 9789559543404, 159 pages | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | <https://www.springer.com/journal/12594> | | | | | | | | | | | | |

**Course Outcome:**

CO1: students understand the basis of writing skills.

CO2: students practice how to write the technical reports

CO3: Students learn about the styles and form , grammar, spelling and conclusion

CO4: Student gain about the writing practices

CO5: Understand to prepare the poster presentation and preparation of project proposals

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-IV: Engineering and Mining Geology ( II Year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Engineering and Mining Geology** | Core | Y | - | - | - | 4 | | 4 | 25 | | 75 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To enumerate the different aspects of engineering geology | | | | | | | | | | | | |
|  | To briefly summarise the properties and significance of different Earth materials on the basis of engineering geology | | | | | | | | | | | | |
|  | To briefly summarise the properties and significance of different Earth materials on the basis of engineering geology | | | | | | | | | | | | |
|  | To employ the students in geotechnical investigations and make them understand the various mining methods adopted in addition to estimation of ore reserves | | | | | | | | | | | | |
|  | To theories the knowledge | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Engineering geology: Engineering properties of rocks, soft sediments and soils – Geological investigations pertaining to bridges, buildings, dams, highways and airfields – Types of reservoirs – Geological investigations of reservoir sites. | | | | | | | 12 | | | CO1 | | |
| II | Problems pertain to tunneling in hard and soft grounds – Geological investigations preceding tunneling – Geological investigations pertaining to harbors, docks, coastal erosion – Shoreline engineering – Construction of retaining walls – Problems and solutions. | | | | | | | 12 | | | CO2 | | |
| III | Mining geology: Terminology used in metal mines – Terminology used in coal mines – Prospecting and exploration – Alluvial mining methods – Quarrying – Opencast mining – Mine supports – Mine atmosphere. | | | | | | | 12 | | | CO2 | | |
| IV | Methods of underground metal mining: Without artificial supports – With artificial supports – Cut and fill methods – Shrinkage stoping – Caving methods. | | | | | | | 12 | | | CO2 | | |
| V | Coal mining: Longwall advancing – Longwall retreating – Board and Pillar method – Horizon mining. | | | | | | | 12 | | | CO2 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Arogyaswamy, R.N.P. (1996) *Courses in Mining Geology*. 4th Edition. Oxford and & IBH Publishing Co., New Delhi. | | | | | | | | | | | | |
| 2. | Peters, W.C. (1978) *Exploration and Mining Geology*. 2nd Edition. John Wiley & Sons, New York | | | | | | | | | | | | |
| 3. | Vitousek P.M, Global Change and Natural Resource Management, Beyond global warming:Ecology and global change. Ecology 75, 1861-1876. | | | | | | | | | | | | |
| 4. | Miller T.G. Jr, Environmental Science, Wadsworth Publishing Co. (TB) | | | | | | | | | | | | |
| 5. | Thomas,R.T, Introduction to Mining methods, McGraw Hill, New York(1986) | | | | | | | | | | | | |

|  |  |
| --- | --- |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | |
| 1. | Blyth, F.G.H. (1963) *A Geology for Engineers*. 4th Edition. The ELBS & Edward Arnold (Publishers) Ltd., London |
| 2. | Legget, H.F. and Hatheway, A.W. (1988) *Geology and Engineering*. 3rd Edition. McGraw-Hill Book Co., New York |
| 3. | Arogya swamy R.N.P, Courses in Mining Geology, Oxford &IBH, New Delhi(1988) |
| 4. | Singh, R.D, Coal Mining, New Age Publishers, Delhi(1998) |
| 5. | Hartman, H.L, SME Mining Engineering Handbook, SME Colorado, USA (1992) |
| **Web Resources** | |
| 1. | https://link.springer.com/chapter/10.1007/ |
| 2. | https://www.sciencedirect.com/sciencedirect.com/science/article/pii/ |
| 3. | https://www.google.com/ur1?sa=t&source=web&rct=j&ur1=https//mines.gov.in/ |
| 4. | https://www.ncbi.nml.gov/books/ |
| 5. | https://www.sciencedirect.com/sciencedirect.com/science/article/pii/ |

**Course Outcome:**

**CO1:** Students can understand the Engineering properties of rocks

**CO2:** student can apply the knowledge and ideals on geological investigations for constructions

**CO3:** Getting knowledge about the alluvial mining methods

**CO4:** Study themethods of underground metal mining

**CO5:** Understand the knowledge about the coal mining methods and techniques

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 |
| **CO 2** | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 |
| **CO 3** | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 |
| **CO 4** | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 |
| **CO 5** | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-IV: Engineering, Mining Geology and Geochemistry Practical ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PSO Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Engineering, Mining Geology and Geochemistry Practical** | Core | Y | - | - | - | 4 | | 4 | 40 | | 60 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To enumerate need of practical knowledge in the field | | | | | | | | | | | | |
|  | To conduct the field surveys for mineral exploration | | | | | | | | | | | | |
|  | To briefly summarise the various mining methods adopted in addition to estimation of ore reserves | | | | | | | | | | | | |
|  | To employ the students in geotechnical investigations | | | | | | | | | | | | |
|  | To critically assess the properties of rocks, minerals and ores | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Engineering Geology: Determination of specific gravity, porosity, void ratio, moisture content, degree of saturation, Atterberg limits, and unit weights. Granulometric curves – Uniformity co-efficient – Dry and wet density curves – Mohr’s stress circle – Ultimate    and safe bearing capacity of cohesive and non-cohesive soils. | | | | | | | 12 | | | CO1 | | |
| II | Mining Geology: Assaying – Determination of average grade – Determination of average width – Uniform sampling – Variable sampling – Influence of interval. Drilling: Core and sludge recovery – Estimation of ore reserves – Determination of coal pillar size – Determination of ideal shaft location. | | | | | | | 12 | | | CO2 | | |
| III | Geochemistry: Analysis of rocks/minerals/ores – Analysis of water – Elemental analysis – Flame photometry – Spectrophotometry –Analysis of trace elements using AAS – ICPMS – radioactive dating methods | | | | | | | 12 | | | CO2 | | |
|  |  | | | | | | | | | | | | |
| 1. | Krynine, D.P. and Judd, W.R. (1957) *Principles of Engineering and Geotechniques*. McGraw-Hill Book Co., New York | | | | | | | | | | | | |
| 2. | Legget, H.F. (1962) *Geology and Engineering*. McGraw-Hill Book Co., New York | | | | | | | | | | | | |
| 3. | Dobrin. M.B– introduction to Geophysical prospecting. McGraw–Hill, 1981 | | | | | | | | | | | | |
| 4. | Mason. B, Principles of geochemistry– Willey Toppan, 1966. | | | | | | | | | | | | |
| 5. | H.E. Hawkes and Webb, ,Geochemistry in Mineral Exploration, Harper and Row Publishers1965. | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Zaruba, Q. and Menci, V. (1976) *Engineering Geology*. Elsevier Scientific Publishing Co., Amsterdam | | | | | | | | | | | | |
| 2. | Arogyaswamy, R.N.P. (1980) *Courses in Mining Geology*. 2nd Edition. Oxford and & IBH Publishing Co., New Delhi. | | | | | | | | | | | | |
| 3. | Govett, G.J.S.Handbook of Exploration Geochemistry.(Ed) , 1983. | | | | | | | | | | | | |
| 4. | Craig,R.C& D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York.(1985) | | | | | | | | | | | | |
| 5. | Aiyengar, N.K.N, Minerals of Madras, Dept.of Industries &Commerce. Guindy, Madras, (1964). | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | 1. https://www.Sciencedirect.com | | | | | | | | | | | | |
| 2. | https://www.geos.iitb.ac.in | | | | | | | | | | | | |
| 3. | https://pubs.usgs.gov | | | | | | | | | | | | |
| 4. | https://www.britannica | | | | | | | | | | | | |
| 5. | https://www.intechopen.com | | | | | | | | | | | | |

**Course Outcome:**

CO1: The student is introduced to a detailed discussion, study, and application of engineering properties of rocks

CO2: Student can learn the formulas for Estimation of ore reserves

CO3: student learn the mining geology calculations

CO4: Students can understand the sophisticated instrumental operations for analysis

CO5: Student apply the techniques for analysis of rocks/minerals/ores.

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 2** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 4** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 5** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-IV: Geological Field Tour ( II Year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Geological Field Tour** | Core | Y | - | - | - | 4 | | 4 | 40 | | 60 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | Understand the occurrence of various mineral resources across the country. | | | | | | | | | | | | |
|  | Students will comprehend the importance of various mining methods that are being adopted in the country. | | | | | | | | | | | | |
|  | Interpret the occurrence of mineral resources and its relationship with various geological and geotechnical processes. | | | | | | | | | | | | |
|  | Acquiring practical knowledge through actual field visits and interaction with subject experts | | | | | | | | | | | | |
|  | Evaluate the importance of mineral exploration techniques. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Students will be taken to various mines and mineral exploration industries across the country to gain first hand field experience on various mining methods, R&D activities in mineral exploration, interaction with subject experts in various industries and organizations involved in mineral exploration activities. | | | | | | | 12 | | | CO1 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Lisle, R.J. (1988). Geological Structures and Maps. Pergamon Press, Oxford. | | | | | | | | | | | | |
| 2. | Brian Simpson. (1968). Geological Maps. Pergamon Press Limited, Oxford | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Thomas, J.A.G. (1977). *An Introduction to Geological Maps*. George Allen and Unwin (Publishers) Limited, London. 2nd Edition. | | | | | | | | | | | | |
| 2. | Bhattacharya, D.S. and Bagchi, T.C. (1973). *Elements of Geological Map Reading and Interpretation with Exercises*. Orient Longman Limited, Calcutta. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | Journal of Geological Society | | | | | | | | | | | | |

**Course outcomes**

CO1: students learn the practical knowledge in the field visit

CO2: students identify and collect the rock specimens in the field visit

CO3: students experienced in mining areas and learn about the mining techniques.

CO4: students get interaction with eminent scientist at various institutions during filed visit

CO5: Students prepare the field training reports and gain knowledge about the geological sites.

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 2** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 4** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |
| **CO 5** | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-IV: Oceanography and Climatology ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Oceanography and Climatology** | Elective | Y | - | - | - | 3 | | 4 | 40 | | 60 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To learn the physical and chemical components and phenomena related to oceanography and climatology | | | | | | | | | | | | |
|  | To understand the morphologic and tectonic domains of the ocean floor | | | | | | | | | | | | |
|  | Compare and Contrast cloud physics and Physical Meteorology | | | | | | | | | | | | |
|  | Critically assess the ocean current patterns and cloud-climate classifications | | | | | | | | | | | | |
|  | To differentiate and understand the different Oceanic Currents | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Oceans and Atmosphere Hypsography of the continents and ocean floor –continental shelf, slope, rise and abyssal plains. Physical and chemical properties of sea water and their spatial variations. Residence times of elements in sea water. Ocean currents, waves and tides, important current systems, thermohaline circulation and the oceanic conveyor belt. Major water masses of the world’s oceans. Biological productivity in the oceans. | | | | | | | 12 | | | CO1 | | |
| II | Structure and chemical composition of the atmosphere, lapse rate and stability, scale height, geopotential, greenhouse gases and global warming. Cloud formation and precipitation processes, heat budget, radiation balance. El Nino Southern Oscillation (ENSO). General weather systems of India, - Monsoon system, cyclone and jet stream, Western disturbances and severe local convective systems, distribution of precipitation over India. . Marine and atmospheric pollution, ozone depletion. | | | | | | | 12 | | | CO2 | | |
| III | Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Hydrothermal vents-. Ocean margins and their significance. Ocean Circulation, Coriolis Effect and Ekman spiral, convergence, divergence and upwelling, El Nino – La Nina, Indian Ocean Dipole Thermohaline circulation and oceanic conveyor belt. | | | | | | | 12 | | | CO3 | | |
| IV | Physical Meteorology: Thermal structure of the atmosphere and its composition. Radiation: basic Laws - Rayleigh and Mie scattering, multiple scattering, radiation from the sun, solar constant, effect of clouds, surface and planetary albedo. Emission and absorption of terrestrial radiation, radiation windows, radiative transfer, Greenhouse effect, net radiation budget; Clausius – Clapeyron equation. | | | | | | | 12 | | | CO4 | | |
| V | Cloud Physics: Cloud classification, condensation nuclei, growth of cloud drops and ice-crystals, precipitation mechanisms: Bergeron, Findeisen process, coalescence process. Atmospheric turbulence: Mixing length theory, planetary boundary layer equations, surface layer, Ekman layer, eddy transport of heat. Richardson criterion. | | | | | | | 12 | | | CO5 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Kennett, J.P. (1982) *Marine Geology*. Prentice Hall, London. | | | | | | | | | | | | |
| 2. | Seibold, E. and Berger, W.H. (1982) *The Sea Floor*. Springer Verlag, Berlin | | | | | | | | | | | | |
| 3. | [Sverdrup, Harald Ulrik](https://en.wikipedia.org/wiki/Harald_Sverdrup_(oceanographer)); [Johnson, Martin Wiggo](https://en.wikipedia.org/wiki/Martin_W._Johnson); Fleming, Richard H. (1942). [The Oceans, Their Physics, Chemistry, and General Biology](http://ark.cdlib.org/ark:/13030/kt167nb66r/). New York: [Prentice-Hall](https://en.wikipedia.org/wiki/Prentice-Hall). | | | | | | | | | | | | |
| 4. | Rice, A. L. (1999). ["The Challenger Expedition"](https://books.google.com/books?id=F5agn3NSzEoC&pg=PA27). Understanding the Oceans: Marine Science in the Wake of HMS Challenger. [Routledge](https://en.wikipedia.org/wiki/Routledge). | | | | | | | | | | | | |
| 5. | [Benjamin Franklin's 'Sundry Maritime Observations'"](https://web.archive.org/web/20051218185445/http:/oceanexplorer.noaa.gov/library/readings/gulf/gulf.html). Archived from [the original](http://oceanexplorer.noaa.gov/library/readings/gulf/gulf.html) on 18 December 2005. | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Strahler, A.N. and Strahler, A.H. (1987) *Modern Physical Geography*. 3rd Edition. John Wiley & Sons, New York. | | | | | | | | | | | | |
| 2. | Strahler, A.N. (1974) *Physical Geography*. 4thEdition.John Wiley & Sons, New York. | | | | | | | | | | | | |
| 3. | Boling Guo, Daiwen Huang. [Infinite-Dimensional Dynamical Systems in Atmospheric and Oceanic Science](http://www.worldscientific.com/worldscibooks/10.1142/9106), 2014, World Scientific Publishing, [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-981-4590-37-2](https://en.wikipedia.org/wiki/Special:BookSources/978-981-4590-37-2). | | | | | | | | | | | | |
| 4. | Hamblin, Jacob Darwin (2005) [Oceanographers and the Cold War: Disciples of Marine Science](https://books.google.com/books?id=6jrUK226eRgC&dq=Hamblin+%22Oceanographers+and+the+Cold+War%22&pg=PP1&ots=0Us_ku7jpm&sig=bck0Mb9eT9Ih-RmDrRIs_nWzzg0&hl=en&sa=X&oi=book_result&resnum=1&ct=result). University of Washington Press. [ISBN](https://en.wikipedia.org/wiki/ISBN_(identifier)) [978-0-295-98482-7](https://en.wikipedia.org/wiki/Special:BookSources/978-0-295-98482-7) | | | | | | | | | | | | |
| 5. | Lang, Michael A., Ian G. Macintyre, and Klaus Rützler, eds. [Proceedings of the Smithsonian Marine Science Symposium.](http://www.sil.si.edu/smithsoniancontributions/MarineSciences/sc_RecordSingle.cfm?filename=SCMS-0038) Smithsonian Contributions to the Marine Sciences, no. 38. Washington, D.C.: Smithsonian Institution Scholarly Press (2009)  Roorda, Eric Paul, ed. The Ocean Reader: History, Culture, Politics (Duke University Press, 2020) 523 pp. [<http://www.h-net.org/reviews/showrev.php?id=58118> | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | <https://en.wikipedia.org/wiki/British_Oceanographic_Data_Centre> | | | | | | | | | | | | |
| 2. | <https://psl.noaa.gov/data/gridded/tables/ocean.html> | | | | | | | | | | | | |
| 3. | <http://www.vega.org.uk/video/> | | | | | | | | | | | | |
| 4. | <https://unesdoc.unesco.org/ark:/48223/pf0000030893> | | | | | | | | | | | | |
| 5. | [<http://www.mcirano.ufba.br/ftp/books/baum_04.pdf>](https://web.archive.org/web/20110927020036/http:/stommel.tamu.edu/~baum/paleo/ocean/) | | | | | | | | | | | | |

**Course Outcome:**

CO1: Students can introduce into the Physical and chemical properties of sea water

CO2: Students learn about the Structure and chemical composition of the atmosphere

CO3: Gain knowledge in the Morphologic and tectonic domains of the ocean floor Structure

CO4: Students can introduce into Physical Meteorology

CO5: Studied and gain knowledge on Cloud Physics

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-IV: Petroleum Exploration and Mud logging ( II Year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Petroleum Exploration and Mud logging** | Elective | Y | - | - | - | 3 | | 4 | 40 | | 60 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | To Identify and enumerate the methods of drilling. To describe and explain the oil resources. To summarize the whole procedure involved in exploitation of oil resources | | | | | | | | | | | | |
|  | To interpret and select the prospering area for exploitation of | | | | | | | | | | | | |
|  | Compare and contrast the differences between prosperous and non-economical sites. | | | | | | | | | | | | |
|  | Critically assess and review the ideas at strategic situation at the drilling site | | | | | | | | | | | | |
|  | Can make hypothesis to achieve the target | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Petroleum Exploration – Petroleum Geology - Applied Mathematics in Petroleum Engineering. Oil Field Drilling – Onshore and Offshore Drilling - Drilling Rigs – Well Types - The Drill String – Drill Bits – Well Profile- Bore-hole volume Calculation and Displacement – Lag time – Basic Hydraulics - Drilling Fluids - Formation Pressure –Bore Hole Problems - Coring –Objective of Coring and Core Analysis- Casing and Cementing – Fishing - Well Completion – Well Testing. | | | | | | | 12 | | | CO1 | | |
| II | Basics of Mudlogging –Surface Logging - Tasks and Responsibilities - Geological Surveillance – Cutting Sampling - Collection, Examination – Lithological and Mineralogical Description–Calcimetry - Oil Shows- Fluorescence and Cut Fluorescence – Thin Sections – Chemical Tests – Gas Sampling – Hydrocarbon Gas Analysis – Pore Pressure calculation - Cutting Evaluation – Sample Examination Procedure - Wellsite Geo-Chemistry - Gases other than Hydrocarbons, Communication Skill - QHSE – Worksite Environmental Hazards – Offshore Safety - Quality Control. | | | | | | | 12 | | | CO2 | | |
| III | MudloggingServices, Mudlogging Sensors –Operations – Maintenance - Inspection and calibrations–Trouble shooting - Technical Specification - Reporting - Final Well Reports - Mudlogging Unit Installation and Maintenance.Practical Mudlogging, Lab Training on Rig up and Rig Down of Sensors, Equipment and Monitoring Realtime drilling followed by a Rig site Visit. | | | | | | | 12 | | | CO3 | | |
| IV | Down-hole Measurement - Measuring While Drilling (MWD) – MWD Principle – Telemetry Types – Formation Evaluation MWD- Sensor information – Natural Gama ray – Formation resistivity – Focused Current Resistivity (FCR) – Toroidal Resistivity – Electromagnetic Wave Propagation Resistivity – Multiple Propagation Resistivity (MPR) – Geo-Steering- Neutron Porosity MWD Tools – Formation Density MWD Tools – Drilling Performance MWD. | | | | | | | 12 | | | CO4 | | |
| V | Down-hole Logging - Logging While Drilling (LWD) – Temperature Logs – Caliper Logs – Self Potential Logs (SP) – Resistivity & Conductivity Logs – Gama ray and Spectral Gama ray logs – Sonic Logs – Density and Photo Electric factor Logs – The Neutron Log – The dip meter – Imaging Logs –MDT Sampling - Lithology reconstruction from Logs- Facies Sequences and depositional environments from Logs – Sequence Stratigraphy and Stratigraphy. | | | | | | | 12 | | | CO5 | | |
|  |  | | | | | | | | | | | | |
| 1. | Levorsen, A.J. (2004). *Geology of Petroleum*, CBS Publishers and Distributors Pvt Ltd., Chennai. 2nd Edition. | | | | | | | | | | | | |
| 2. | Bhagwan Sahay. (1997). *Petroleum Exploration and Exploitation Practices*, Allied Publishers Limited, Chennai. 2nd Edition. | | | | | | | | | | | | |
| 3. | Geology& Mineral Resources of the States of India. Misc Pub.No.30.Geological Survey of India. Kolkota. (Several individual volumes available online at GSI portal) GSI(2005). | | | | | | | | | | | | |
| 4. | The Mudlogging Handbook – Alun Whittaker | | | | | | | | | | | | |
| 5. | Brian Frehner. Finding Oil: The Nature of Petroleum Geology, 1859–1920 ([University of Nebraska Press](https://en.wikipedia.org/wiki/University_of_Nebraska_Press); 2011) 232 p | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Mudlogging Training Manuals – GEOLOG International B.V | | | | | | | | | | | | |
| 2. | The Mudlogging Handbook – Alun Whittaker | | | | | | | | | | | | |
| 3. | An Introduction in Stratigraphy, Stamp L.D, (1964), Thomas Murby, Museum St, WCI, London. | | | | | | | | | | | | |
| 4. | Stratigraphic Principles and Practices, Weller, J.M, (1962), Harper & Bros, New York | | | | | | | | | | | | |
| 5. | Wadia,D.N, Geology of India, McMillan India Delhi(1953) | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. | https://stratigraphy.org/ | | | | | | | | | | | | |
| 2. | https://www.sepm.org/ | | | | | | | | | | | | |
| 3. | https://www.geosocindia.org/ | | | | | | | | | | | | |
| 4. | https://www.moes.gov.in/ | | | | | | | | | | | | |
| 5. | https://isegindia.org/ | | | | | | | | | | | | |

**Course Outcome:**

**CO1:** Students gain knowledge about the Petroleum Exploration

**CO2** Students learn about theBasics of Mudlogging

**CO3:** Students get knowledge on MudloggingServices, Mudlogging Sensors –Operations – Maintenance

**CO4:** Students know about the Down-hole Measurement

**CO5:** Students able to learn on Down-hole Logging

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 2** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 5** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Semester-IV: Individual Social Responsibility ( II year)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **O** | **Credits** | | **Inst. Hours** | **Marks** | | | | |
| **CIA** | | **External** | **Total** | |
|  | **Individual Social Responsibility** | Soft Skill | Y | - | - | - | 2 | | 4 | 40 | | 60 | 100 | |
| **Course Objectives** | | | | | | | | | | | | | |
|  | Understand the importance of Individual Social Responsibility (ISR) | | | | | | | | | | | | |
|  | Students will comprehend the importance of CSR, volunteerism and the role of youth in ISR. | | | | | | | | | | | | |
|  | Based on the understanding of the basics, the students are expected to participate in debate and group activities to highlight the importance of stakeholder’s participation in ISR. | | | | | | | | | | | | |
|  | Acquiring advanced skills in community participation and taking up field-based research. | | | | | | | | | | | | |
|  | Evaluate the importance of ISR in technology transfer. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | **No. of Hours** | | | **Course Objectives** | | |
| I | Concept and importance of social responsibility - Define Philanthropist responsibilities, Ethical responsibilities, Legal responsibilities, Environmental responsibilities. Importance of Individual Social Responsibility - Cycle of ISR, role of NGO’s, linkage between ISR and environment and the role of youth in social responsibility. | | | | | | | 12 | | | CO1 | | |
| II | Four dimensions of social responsibility, various key elements of ISR. Introduction on Corporate Social Responsibility (CSR). Importance of volunteerism and the linkage among rights and ISR. Role of media with reference to social responsibility, steps to achieve ISR and the ways to make ISR successful. | | | | | | | 12 | | | CO2 | | |
| III | Debate and groups activities on the role of stakeholders in social responsibility – Discussions on the importance of ISR in the post pandemic Covid-19 and other natural disasters – Debate on Ideal Life Cycle. | | | | | | | 12 | | | CO3 | | |
|  | **Text Books** | | | | | | | | | | | | |
| 1. | Responsible People – The Role of the Individual in CSR, Entrepreneurship and Management Education (Editors) Farache, F et. Al., Palgrave Macmillan eBook, 283 pp (2019). | | | | | | | | | | | | |
| 2. | Mandated Corporate Social Responsibility: Evidence from India (Editors) Nayan Mitra & Rene Schmidpeter, Google Books, 261 pp (2019). | | | | | | | | | | | | |
| **References Books**  **(Latest editions, and the style as given below must be strictly adhered to)** | | | | | | | | | | | | | |
| 1. | Social Responsibility by Ingrid Muenstermann, Google Books, 160 pp (1967). | | | | | | | | | | | | |
| 2. | <https://saylordotorg.github.io/text_human-relations/s09-03-social-responsibility.html> | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1. |  | | | | | | | | | | | | |

**Course Outcome:**

**CO1:** Gain knowledge on importance of social responsibility

**Co2:** students learn the Four dimensions of social responsibility

**CO3:** Students get ideas on role of media with reference to social responsibility

**CO4:** Students get involved in the Debate and groups activities

**CO5:** Debate and groups activities on the role of stakeholders in social responsibility

**Mapping with Programme Outcomes:**

**Map course outcomes for each course with programme outcomes (PO) in the 3-point scale of Strong, Medium and Low**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** |
| **CO 1** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 2** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **CO 5** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**S-Strong-3 ; M-Medium -2 ; L-Low-1.**

**Program Specific Outcomes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** |
| **CO 1** | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

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