P G DEPARTMENT OF GEOLOGY

UNIVERSITY OF JAMMU

DEPARTMENTAL PROFILE

&

SYBALLBUS (As Per NEP 2020)

2025

UNIVERSITY OF JAMMU

A Beacon of Excellence in Higher Education

Established on September 5, 1969, under the Kashmir and Jammu Universities Act 1969, the **University of Jammu** has emerged as one of India's leading higher education institutions. It has earned an **'A++' accreditation from the National Assessment and Accreditation Council (NAAC)** in its 4thCycle (2024) with an impressive **CGPA of 3.72**. The University of Jammu has also been ranked 50th in the National Institutional Ranking Framework (NIRF 2024) under University Category by Ministry of Education, Government of India and ranked 23rd in the State Public University Category.

The University operates from its **main campus at Bahu Wali Rakh** (spread across 118.78 acres) and an **old campus** 4 km away. Additionally, it has **seven offsite campuses** located in Bhaderwah, Kathua, Kishtwar, Poonch, Ramnagar, Reasi, and Udhampur. With **40 teaching departments and 164 affiliated colleges**, the University offers more than **60 undergraduate and postgraduate degree programs, and around 40 Ph.D. programmes under the faculties of Arts, Sciences, Social Sciences, Life Sciences, Mathematical Sciences, Education, Business Studies and Law**. These programmes are dedicated to delivering robust teaching, learning, and research.

The University also has a Centre for Distance and Online Education (CD & OE) in its main campus which is engaged in offering higher education opportunities beyond the brick and mortar world. The Centre for Distance and Online Education is fully committed to optimally harnessing its human capital, infrastructure, learning resources and support services to enhance the quality of design and delivery of the courses offered. Currently, the CD & OE offers 14 programmes (3 UG and 11 PG) and 2 Online programmes.

The University facilitates research activities in line with the University's Vision and its Research Policy. The University receives significant extramural funding, supporting numerous projects. In the last 5 years, the University has been sanctioned about more than 120 research projects to the tune of Rs. 43 crores. The departments of the university also have collaborations with international institutions and universities for global outreach. To name a few, the Department of Biotechnology has been collaborating with Institute of Plant Genetics (Germany), Penn State University (USA), Kanas State University (USA), etc. Department of Physics has been collaborating in various front-line experiments based at CERN, Geneva, Switzerland since 1985, at Fermilab and Brookhaven, USA(CBM) experiment at the FAIR facility at GSI, Darmstadt in Germany etc.

University of Jammu has also collaborated with the country's prestigious institutions – IISc., Bangalore; IIT, Mumbai; Indian Space& Research Organization (ISRO); ihub Divyasampark, a joint venture of Indian Institute of Technology-Roorkee (IIT Roorkee) & Department of Science& Technology, Government of India.

Recently, the University has taken several initiatives to promote a culture of research and innovation through creation of Research Fund and introduction schemes like Seed Grants and Research Grants for the faculty members. University has also launched a "Transdisciplinary Research Scheme" to encourage faculty to take up projects that address societal challenges, particularly those in the Jammu and Kashmir region. For the first time, Students of the post graduate programmes are also being associated in the Transdisciplinary Scheme.

One of the pioneering initiatives in the recent times is the establishment of the Skill Incubation Innovation Entrepreneurship Development Centre (SIIEDC) in the University, which recently launched it's unique flagship 4-Year "Design Your Degree"' programme. With the motto, "Teach to Transform, Educate to Empower and Learn to Lead", the program equips students with the agility and skills required to excel in diverse professional spheres. This transdisciplinary, student-centric initiative reflects the University's progressive mindset and ability to implement NEP 2020 recommendations meaningfully.

The University Campus is bustling with activities, thus creating a vibrant culture & promote holistic development of the students. Twelve clubs **(Dance, Music, Film, Theatre, Photography, Painting, Science Club, Literary, Translation, Heritage & Tourism, Nature & Wildlife and Community Service & Social Justice)** in line with NEP-2020 under the umbrella term "**UTSAAH**" were established recently.

Amongst its other initiatives, the University of Jammu is also the first University of the UT to start a Community Radio Station, "91.2 FM: DHWANI"- A platform to showcase the University's activities, connect with the society on emerging issues, showcase local talent and share good practices. Above all, it gives the students an opportunity to enhance their creative talents and upgrade their skills.

The University is continually adapting to the changing higher education scenario and moving towards becoming a Centre of Excellence in Research and Academics in the region.

STUDENT SUPPORT AND WELFARE

1. **Central Library:** The Central Library of the University, the "Dhanvantri Library" is housed in a three storied building constructed over an area of 60,000 sq.ft. It has a rich collection of books, journals and periodicals, manuscripts, dissertations, thesis etc. which cater to the varied academic and research needs of the users.The library has large reading halls and compact stack areas with open access. About 750 students can be accommodated in the reading area of the library.

2. **Health Centre:** Health Centre in the university is established to provide medical aid benefits to the University community and the dependents of the University employees. The facilities provided are OPD level treatment; Emergency Service; Dental treatment, Physiotherapy and different Lab tests.

3. **Hostels:** The University of Jammu provides hostel facility to its students and scholars. There are three girls hostels located on the main campus and five boys hostels, one of which is located in the old campus and the other four in the new campus. The allotment to the hostels is done by Provost Hostels on the basis of merit, to those students who reside beyond 45 km (for girls) and more than 60 kms (for boys) from the University Campus.

4. **National Service Scheme (NSS):** The National Service Scheme was started to establish a meaningful linkage between the campus and the community. The NSS was started in the University of Jammu in the year 1981. The University of Jammu gives substantial credit to NSS Volunteers for seeking admission in the various post graduate courses of the University of Jammu on the basis of their performance as an NSS volunteer. In recent past, NSS in the University of Jammu has made tremendous strides in the field of social work, community extension reach out and personality development.

5. **Student Welfare:** The office of the Dean Students Welfare, established in 1972, is responsible for planning, organizing and conducting students welfare programmes including cultural and literary activities, festivals, extension and special lectures etc. It monitors the facilities for organizing various academic and cultural/literary activities, working of the cafeteria, canteens, kiosks, Super Bazaar for various student services in the campus. It is also responsible for maintaining discipline and law & order in the campus. The University campus also houses a Bank and a Post Office.

6. **General Zorawar Singh Auditorium Complex (GZSAC):** The General Zorawar Singh Auditorium Complex, is a mega infrastructure facility of the University established in 2007 with a seating capacity of around 1400. The Complex also has a brainstorming room, a reading room cum library, an exhibition hall, a souvenir shop, a green room etc.The major collection of the Gallery is of contemporary paintings.

7. **Brigadier Rajinder Singh Auditorium (BRSA):** The Brigadier Rajinder Singh Auditorium has a seating capacity of 320. It has two green rooms and is centrally air conditioned with sophisticated sound system.

8. **Sports Facilities:** The Sports Infrastructure on the Campus includes a Cricket Ground with net facility, Football Ground, Basketball/ Handball/Kho-Kho/Volley Ball/Lawn Tennis Courts, Athletic Track (400mts.), University Fitness Centre etc. The university also has a Gymnasium Hall, which has been recently named, as P. V. Sindhu Gymnasium Hall. The other sports facilities include, Synthetic Handball court, Synthetic Basketball Court, Practice nets, Cemented Kho-Kho Ground, Boxing Arena, Indoor Games (Badminton, Kabaddi, Wrestling, etc), Fencing Hall, Table Tennis Hall, Sports Training Hall, Hockey Field, Sports Hostel, Yoga Centre, Archery and Fitness Centre.

9. **Centre for IT enabled services and Management**
   Through the Centre for IT enabled Services and Management, the University offers essential ICT services including Internet Access, e-mail, IT security, Wi-Fi access, development and maintenance of Various University Portals, Problem diagnostics and troubleshooting etc. The Centre provides 24*7 Internet facility to all the users in the University including teaching, administrative staff, students, scholars in all facilities/departments throughout the campus.

10. **Green Initiatives for promoting sustainability and environmental consciousness on the campus:**

    University of Jammu is proactively taking steps in raising awareness amongst its students, scholars, faculty members and administrative staff to protect the environment through education, research, sustainable practices, awareness campaigns, collaborations, and conservation projects. University of Jammu has constituted a Green Campus Task Force (GCTF-JU), comprising of teachers in-charge and students, scholars, from all the departments of University with the Department of Environmental Sciences, University of Jammu being the nodal agency to ensure its smooth functioning in the campus. Some of the initiatives of GCTF-JU include:
    - Digitization of flora of the campus
    - Ban on entry of 4 wheelers, Introduction of e-vehicles

- Installation of Roof- Top Solar Panels
- Rain Water Harvesting
- Sewage Treatment Plant
- Recycling of waste materials
- Construction of vertical gardens using waste plastic bottles.

11. **Jammu University Internal Complaints Committee against Sexual Harassment (JUICCASH) and Anti-ragging Committee:**

    The University of Jammu has constituted committees for cases related to Sexual Harassment and Anti-ragging.

HELPLINE NUMBERS:

ANTI-RAGGING

UGC Toll free No. 1800-180-5522
Prof. Prakash C Anthal (Chief Proctor & Dean Student Welfare): +91-94191-45175
Dr. Shallu Sharma (Deputy Chief Proctor): +91-94692-12553
Dr. Abdul Rashid Manhas (Deputy Chief Proctor): +91-94191-53883

JUICCASH

Prof. Namrata Sharma (Presiding Officer): +91-90860-03468

STUDENT INDUCTION POLICY

"Igniting Potential, Inspiring Purpose"

1. PURPOSE

The purpose of this policy is to ensure a smooth transition and integration of newly admitted students into the academic, social, and cultural environment of the University. The induction program is designed to familiarize students with the university's core values, expectations, resources, and support services, while inspiring, motivating and igniting the **SPARK** within them to unlock their inner potential.

S–**Socialize**: Foster connections among peers and with faculty to build a sense of community.
P– **Participate**: Actively engage in all induction activities to immerse oneself in the campus culture.
A– **Associate**: Build relationships through group activities, clubs, and collaborative tasks.
R– **Reflect**: Encourage introspection and personal growth through self-awareness sessions.
K– **Know**: Gain understanding of institutional values, governance, academic structure, and societal roles.

2. SCOPE

This policy applies to all newly admitted students across all academic programs and levels.

3. OBJECTIVES

- To welcome students and make them feel part of the institution.
- To familiarize students with academic programs, rules, and expectations.
- To introduce students to campus facilities, services, and support structures.
- To build connections among students, faculty, and staff.
- To promote awareness of student responsibilities and institutional policies.

4. INDUCTION PROGRAM STRUCTURE

Students arrive with varied perspectives, backgrounds, and levels of preparation. It is essential to support their transition into the new environment and instill in them the values and ethos of the institution, along with a sense of greater purpose.

With this in mind, University of Jammu recommends **a 3-day induction program** for students before the start of regular classes, which will commence only after the completion of this program. The objective is to help students feel at ease in their new surroundings, establish a healthy daily routine, foster a sense of camaraderie within the batch and with faculty members, and nurture self-awareness, social sensitivity, and an appreciation for nature.
During this period, students are expected to participate fully and actively in all the activities planned as part of the induction program.

The induction program will generally take place within the first week of the academic term and include the following components:

	TIME	ACTIVITY
Day 1	**10:00 AM - 10:30 AM**	Institution Orientation by the Dean Students Welfare
	10:30 AM - 01:00 PM	Lectures by noted Alumni
	LUNCH (1:00 to 2:00)	
	2:00 PM - 2:30 PM	• Visit & Familiarization to the School/Departments • Introduction to the Departmental Faculty
	03:00 PM – 05:00 PM	• Allotment of mentors- Introduction of students within the mentor groups • Distribution of Booklet and other material
Day 2	**10:00 AM - 12:00 Noon**	Mentoring/Lectures on Professional Ethics, Universal Human Values & Institutional Code of Conduct
	12:00 – 1:00 PM	Interaction with Departmental Alumni
	LUNCH (1:00 to 2:00)	
	2:00 PM – 05: 00 PM	Visit to Central Facilities (Students to be divided into groups to be accompanied by Faculty Coordinators) Central Library, Sports Facilities, Health Centre, Botanical Garden/Cactus Garden, NSS, NCC, JU-FM Dhwani
Day 3	**10:00 AM - 01:00 PM**	Yoga & Various Sports Activities
	LUNCH (1:00 to 2:00)	
	2:00 PM – 5:00 PM	• Club Activities (as per their choice of Club)

5. RESPONSIBILITIES

- **Dean Academic Affairs**: Oversees planning
- **Dean Students Welfare**: Execution
- **Faculty Coordinators**: Ensure academic readiness and support.
- **Administrative Staff**: Manage logistics, registration, and campus facilities.
- **Student Mentors**: Assist in peer support and community building.

6. FEEDBACK AND EVALUATION

Participants will be asked to provide feedback on the induction program. This will be used to assess effectiveness and improve future sessions.

7. REVIEW

This policy shall be reviewed annually to incorporate feedback and adapt to institutional developments.

Total: 1500 Students (5 groups of 300 each)
5 Sub groups of 60 students each

DAY 2

Time Slot	2:00 p.m. -2:30 p.m.	2:35 p.m. -3:05 p.m.	3.10 p.m. -4:0p.m.	3:45 p.m. -4:15p.m.	4:20 p.m. -5:00 P.m.
Group 1	Central Library	Health Centre	Botanical Garden/Cactus Garden	Museum/ Art Gallery	JU-FM Dhwani
Group 2	Health Centre	Botanical Garden/Cactus Garden	Museum/ Art Gallery	JU-FM Dhwani	Central Library
Group 3	Botanical Garden/ Cactus Garden	Museum/ Art Gallery	JU-FM Dhwani	Central Library	Health Centre
Group 4	Museum/ Art Gallery	JU-FM Dhwani	Central Library	Health Centre	Botanical Garden/Cactus Garden
Group 5	JU-FM Dhwani	Central Library	Health Centre	Botanical Garden/Cactus Garden	Museum/ Art Gallery

P.G. DEPARTMENT OF GEOLOGY
UNIVERSITY OF JAMMU

The teaching of Geology was initiated in Jammu as early as 1907 at Prince of Wales College, now known as Government Gandhi Memorial Science College. This way the PG Department of Geology is second oldest Geology department in India, next only to Presidency College, Calcutta. As a postgraduate subject, Geology was introduced at Jammu by none other than Dr. D.N. Wadia, FRS, who also wrote in Jammu his famous textbook "Geology of India" published in 1919.The Post Graduate teaching in Geology, imitated in Science College under the academic control of Punjab University, Lahore was discontinued during the thirties and forties of 20th century possibly due to recession and was reintroduced again as subject at post graduate level in 1948 under the academic control of the then University of Jammu and Kashmir. The University took it under administrative control in 1956 being the first science subject taught at postgraduate level. After the bifurcation of this University into University of Jammu and Kashmir and University of Kashmir, the postgraduate Department of Geology got affiliated to the University of Jammu in 1969.

The students of this Department have risen to high executive and academic positions, as two former Director Generals (then known as Directors) of Geological Survey of India and Pakistan, are among the alumni of this department. Two assuming the mantle of leaders of expeditions to Antarctica, besides some being the members of five expeditions, one as a member of the first successful India team which scaled Mt. Everest and the same person being deputy leader of the first Indian expedition to Antarctica. The alumnus also comprises people who have attained top positions in the field of industry, research Institutions and Universities, administrations, academics and business. The department offers a four semester course leading to Master's Degree besides programme at Ph.D. levels. The output of the department, in terms of degrees awarded from 1956 till date (December 2023) is: M.Sc. - 1427, M.Phil-101 and Ph.D.-95

The annual intake capacity of the students in the Department is 30. In addition to the normal intake, students are also admitted against payment seats. For the last five years, a number of female students have also sought admission in our Department thereby adopting the adventurous and exciting subject of Geology. This trend is in tune with the rest of the Universities in the country.

The Department has five Professors and One Associate Professors. There are SRFs, JRFs under UGC, DST, ISRO and CSIR schemes. In the last six years (2018- 23), the faculty members of this department sanctioned and completed twelve projects to the tune of Rs. **9, 48, 22,956/-** (Nine Crore, fortyeight lakhs, twentytwo thousand, Nine hundred and fifty six only) by various agencies UGC, DST, MoES, ISRO and CSIR A comprehensive review of the course content and structure is undertaken after every three years in the light of latest developments in the field of earth sciences. The faculty members of the department regularly participated in national and international meets in India and abroad.

FACULTY

1. Dr. P.K. Srivastava
   Professor
   Ore Geology and Mineral Exploration
   Mob. 941912557
   pankajksrivastava@jammuuniversity.ac.in

2. Dr. A.S. Jasrotia
   Professor
   Remote Sensing & GIS
   Mob. 941912557
   asjasrotia1@jammuuniversity.ac.in

3. Dr. S.K. Pandita
   Professor
   Sedimentology, Quaternary Geology & Disaster Management
   Mob. 941912557
   skpandita@jammuuniversity.ac.in

4. Dr. V. Parmar
   Professor
   Palaeontology & Stratigraphy
   Mob.9419149781
   varunparmar@jammuuniversity.ac.in

5. Dr. S.N. Kundal
   Professor
   Palaeontology & Stratigraphy, Sedimentology
   Mb. 9419100818
   somnath@jammuuniversity.ac.in

6. Dr. Yudhbir Singh
   Associate Professor
   Engineering Geology, Disaster Management
   Mb.9419124021
   Yudhbir.singh@jammuuniversity.ac.in

TECHNICAL STAFF

1.	Curator (Sr. Scientific Officer)	Dr.Bashir Ahmad Lone	(9419168069)
2.	Laboratory Assistance	Stanzin Namga	(7006849256)
3.	Museum cum Lecturer Assistant (MCLA)	Vacant	
4.	Photographer	Naresh Kumar	(9906241825)
5.	Section Cutter	Sunil Kataria (Contractual)	(9419252063)
6.	Lab Attendant	Balbir Singh	(9419165326)
7.	Lab Attendant	Madan Lal	(9419900982)
8.	Lab Attendant	Vacant	
9.	Field Collector	Vacant	

MINISTRIAL/LIBRARY/OTHER STAFF

1.	Section Officer	Zaheer Abass	(9419197418)
2.	Professional Assistant	Mittu Billowria	(7006189733)
3.	Sr. Assistant	Vacant	
4.	Storekeeper	Shiv Kumar	(8803477175)
5.	Junior Assistant	Vijay Kumar	(9419916279)
6.	Junior Assistant	Karan Singh Bali	(9086329468)
7.	Attendant	Mukesh Kumar	(9419630419)
8.	Chowkidar	Harvinder	(8082322067)
9.	Personal Assistant to Head	Vacant	
10.	Security Guard	Feyaz Ahmed Haji	(9797485699)

EQUIPMENTS

S. No. Name of the Equipment	**Status**	**Source**	**Actual cost**
1. HP Design Jet Plotter 500 PS	Functional	DST-FIST	1,86,000/-
2. HP Design Jet Scanner A0	Functional	DST-FIST	7,08,900/-
3. Software (Geological, Arc-GIS and Erdas)	Functional	DST-FIST	5,60,000/-
4. Networking and Computational facilities	Functional	DST-FIST	10,00,000/-
5. Logitech CS 330 Trim saw Diamond Cut Blade	Functional	DST-FIST	6,07,409/-
6. Nikon Measuroscope MM 400/L	Functional	DST-FIST	8,55,000/-
7. Ore Microscope with photo micrographic Attachment	Functional	DST-FIST	6,79,456/-
8. Sony MM Projector VPL CX 86 300 Lumens	Functional	UGC Xth Plan Grant	1,61,470/-
9. Logitech Impregnation	Functional	UGC-SAP	17,00,000/-
10.LINK Sys 32 Real-time video Imaging & Measurement System	Functional	UGC	2,70,823/-
11.Total stations (4)	Functional	UGC XIIth Plan Grant	1,61,470/-
12.Ore Microscopes (3)	Functional	UGC-SAP	17,00,000/-
13. Radio Carbon dating	Functional	DST (Project)	33260000/-
14. Liquid Scintillation Counter with sample preparation equipments	Functional	DST	1,96,67,000/-
15. Logitech Thin Section Lapping Machine	Functional	DST-FIST	8,26,886/-
16. BBS Seismograph (7 nos)	Functional	MoES	1,26,00,000/-
17. Stereo Zoom Trinocular Microscope (TZ 240)	Functional	University Grant	1,15,000/-
18. Geological Heating & Freezing Stage (Link am – THMSG600)	Functional	DST	4,82,000/-
19. Polarizing Microscope with photographic attachment (Nikon L 600 POL)	Functional	DST	5,30,000/-
20. Nikon Trinocular Stereoscopic Zoom	Functional	DST	7,48,690/-
21. Uniaxial and triaxial soil testing equipment Microscope SMZ 1500	Functional	UGC Xth Plan Grant	2,50,000/-
22. Scanning Electron Microscope (JEOL)	Non-Functional	DST	8,75,000/-
23. Atomic Absorption Spectrophotometer with Graphite Furnace (Park in Elmer)	Non-Functional	DST-FIST	23,00,000/-

SOFTWARES
GIS softwares: ILWIS, ERDAS-9.2, Rock Ware 2004, Arc Info 9.2

RESEARCH COLLABRATION
(Last six years as per publications)
International

1. University of Concepción, **France**
2. Université Savoie Mont Blanc Institute de, **France**
3. Radioprotection et de Sûreté Nucléaire (IRSN), **France**
4. IS Terre, **France**
5. University of Granada Granada, **Spain**,
6. CNRS, **France**
7. Universities Grenoble Alpes, **France**
8. Institute for Risk & Disaster Reduction and Institute for Global Health, University College London, **London**, **UK**
9. University of Agder, Kristiansand, **Norway,**
10. Senckenberg Naturhistorische Sammlungen Dresden, Museum für Mineralogie und Geologie, Sektion Geochronologie, GeoPlasma Lab, Königsbrücker Landstraße, **Germany**
11. Texas Tech University, Lubbock, **Texas, USA**
12. Energy and Geoscience Institute (EGI), **University of Utah, USA**
13. Maghreb Petroleum Research Group (MPRG), **University College London, UK**
14. Eni Upstream & Technical Services, Via Emilia, **San Donato Milanese, Milano, Italy**
15. Pakistan Petroleum Limited (PPL), **Karachi, Pakistan**
16. College of Earth, Oceans, and Atmospheric Sciences, Oregon State University, **Corvallis, USA**
17. Department of Geology, University of Kansas, **Lawrence, KS, USA**
18. Centre for Archaeology and Historical Studies, **Royal University of Bhutan, Bhutan**
19. UCL Humanitarian Institute, Department of Earth Sciences, Institute for Global Health, **University College London (UCL), UK**
20. Muséum National d'Histoire Naturelle, **France**
21. School of the Environment, University of Massachusetts, **Boston, MA, USA**
22. Department of Geology, Kent State University, **Kent, OH, USA**
23. Department of Chemistry, DePaul University, **Chicago, IL, USA**
24. Geowissenschaftliches Zentrum Göttingen, Universität Göttingen, Göttingen, **Germany**
25. Earth Sciences Department, **University College London**;
26. Palynological Laboratory Services Ltd., Anglesey (North Wales), **UK Clarkson University, Potsdam, NY, USA**
27. ENI Upstream and Technical Services**, Milan, Italy**
28. Universities Grenoble Alpes, Université Savoie Mont Blanc, CNRS, ISTerre, IFFSTAR, 38000 **Grenoble, France**
29. Institut de Radioprotection et de Sûreté Nucléaire, Fontenay-aux-Roses, **France**
30. Biogéosciences, UMR 6282 CNRS/université Bourgogne Franche-Comté, Dijon**, France**
31. National Taiwan Normal University, Department of Earth Sciences, 88 Tingzhou Road Section 4, Taipei 11677, **Taiwan**
32. Institute of Earth Sciences, Academia Sinica, Taipei 11529, **Taiwan;**
33. State Key Laboratory of Ore Deposit Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, 73 Guanshui Road, Guiyang 550002, **China**
34. Department of Earth Science, Graduate School of Science, **Tohoku University**, Aoba-aza,
35. Aramaki, Aoba-ku, Senda 980-8578, **Japan**36. **China University of Geosciences**, Wuhan, **China**
36. **Geological Survey of Canada**, Pacific Division, Vancouver, BC V6E4S6, **Canada**
37. Department of Geoscience, **University of Calgary,** Calgary, AB T2N 1N4, **Canada**
38. **Institute of Earth Sciences**, Lausanne University, Lausanne CH1015, **Switzerland**
39. Department of Geology, University of Cincinnati, Cincinnati, OH 45221-0013, **USA**
40. BCG Parc de la Rouvraie 28, 1018 Lausanne, **Switzerland**
41. Overseas Development Institute, London, **United Kingdom**

National

1. **O. P. Jindal Global University**, Sonipat, Haryana, India
2. **Birbal Sahni Institute of Palaeosciences**, Lucknow
3. Department of Environmental Science, **Jawahar Lal Nehru University,** New Delhi

4. **GGM, Science college**, Jammu
5. Department of Geology, **Govt. M. A. M. College,** Jammu, India
6. Department of Geology, **University of Delhi**
7. **G.B. Pant National Institute of Himalayan Environment**, India
8. Keshav Deva Malviya Institute of Petroleum Exploration (KDMIPE), **Oil and Natural Gas Corporation** Videsh Ltd, New Delhi, India
9. **Geological Survey of India**, Jammu and Kashmir, India
10. **Ministry of Earth Sciences**, Hydrology and Cryosphere, New Delhi
11. Department of remote sensing, **University of Jammu**
12. Department of Geology **Kumaun University**, Nainital, India,
13. Department of Geology, **University of Kashmir.**
14. **Govt. Higher Secondary Scool** Kumb, Khairpur, Pakistan
15. **IGNOU**, New Delhi, India
16. **Wadia Institute of Himalayan Geology**, Dehradun, India
17. **Punjab Engineering College**, India
18. Centre for Glaciology, **Wadia Institute of Himalayan Geology**, 33 GMS Road, Dehradun, India
19. Department of Earth Sciences, **Indian Institute of Technology Roorkee,** Roorkee, 247667, India
20. Department of Civil Engineering, **Indian Institute of Technology Delhi**
21. School of Earth and Environmental Science, **Central University of Himachal Pradesh**, Kangra, H.P., 176 206, India
22. Civil Engineering Department, **Punjab University** , Chandigarh
23. Department of Geology **Banaras Hindu University**
24. **Cluster University of Jammu**
25. **Indian Institute of Technology Delhi**
26. **Physical Research Laboratory,** Ahmadabad
27. **Mahatma Gandhi Mission** Aurangabad, India
28. Indian Institute of Science, **Interdisciplinary Centre for Water Research (ICWaR**, Bengaluru, India
29. Directorate of Geology and Mining, **Jammu and Kashmir Government**, Srinagar, India
30. National Center for Seismology, **Ministry of Earth Sciences**, Lodhi Road, New Delhi
31. Jammu and Kashmir **State Power Development Corporation**
32. **Ministry of Earth Sciences**, Borehole Geophysics Research Laboratory, Karad, India
33. Geoscience/Seismology Division, **Ministry of Earth Sciences**, New Delhi, India
38. Space Applications Centre, **Indian Space Research Organization**, Ahmedabad 380 015, India
41. **Himachal Pradesh Council for Science, Technology and Environment**, Shimla 171 009, India
42. **Remote Sensing Applications Centre**-Uttar Pradesh, Lucknow 226 021, India
43. **Sri Pratap College** Srinagar
44. **Vinoba Bhave** University, Hazaribagh
41. Centre for Climate Change and Water Research, **Suresh Gyan Vihar University**, Jaipur-302011 (RJ), India
45. Depart ment of Geology, **RTNM University Nag pur**
46. Geotechnics & Mine Modelling Section, **CSIR-CIMFR, Nagpur** - 440 001, India

SIGNIFICANT ACHIVEMENTS

- 34 research projects sanctioned to faculty members of the Department of Geology by various agencies tuning Rs.18, 12, 17, 253/- since 2001.
- MOUs with various Institutes

BEST PRACTICE

- Department organizing weekend local geological field work for the students of M.Sc. semester I and one 2-3 weeks long field work out of state for the students of Semester III.
- Introduced eight credits dissertation for Semester IV students.
- Department arranges guest lecturers by the Scientists/Academicians/ Geologists from Industries from time to time for the general benefit of the students.
- The students' driven “Geoclub” has been started from 2016 where students organized Field Photograph and specimen exhibitions, Geological Quiz programmes, lectures etc.
- Regular meetings of departmental bodies, monitoring of purchase, develop links with affiliated colleges, maintenance of log books stock register, files (staff, scholars, students), account books, notices, circulars, requisitions account books, notices, circulars, requisitions
- Department has research collaboration with more than 40 national and 45 international research Institutes as per research publication for the last five years.

PLACEMENTS

- The students of this department placed in various Government/Private agencies. Most of the students not provided the information of their appointment. As per the data available with the department, the following students are appointed in Govt / Private agencies from the last five years and are as under:
- JK Police: 05, Banking: 03: Geologists/consultant: 03; Teachers in School: 05; Finance: 02; Agriculture: 01, Pursuing Ph.D.:09; Pursuing B.Ed: 04; In Private Industries: Reliance Industry – 01, Fraud Analysis, Barclays-01; Others are preparing for competitive exams.

JRF-NET/SET/GATE

- As per available data with office, 07 candidates qualified for JRF-NET/SET/GATE

HONORS/AWARDS/FELLOWSHIPS TO THE FACULTY MEMBERS

Prof. G.V.R. Prasad

- French Government MNHN Fellowship
- National Mineral Award
- National Geographic Field Grants
- UGC Research Award
- INSA Royal Society Fellow, London
- DST-DAAD visiting scientist, Germany
- L. Rama Rao Birth Centenary Award
- Shanti Swarup Bhatnagar Prize
- American Museum of Natural History Collections Study Grant
- University of California, Museum of Paleontology Sameul and Welles Fund
- Society of Vertebrate Paleontology Preparator's Award
- Fellow Indian Academy of Science
- Fellow Indian National Science Academy
- Fellow National Academy of Science

Prof. G.M. Bhat

- YMS Award in Physical Science
- Global Get energy Award
- UNESCO Member of Scientific Board, 2021

Dr. P.K. Srivastava

- DAAD Fellowship, Germany

Dr. A.S. Jasrotia

- Best Paper Presentation Award

Dr. S.K. Pandita

- J&K State DST Young Scientist Award
- Young Sedimentologists Award

Dr. Som Nath Kundal

- Best Presentation award, International Science Congress

Dr. Yudhbir Singh

- J&K State DST Young Scientist Award

LIBRARY FACILITIES

The Department library is well equipped with more than 7000 books related to various branches of Geology. In addition, several national and international research journals (Economic Geology, Gondwana Research, geosciences Journal, Journal of Glaciology, Journal of vertebrate Palaeontology, Journal of Geology, Growth and change, Journal of Micropalaeontology., etc.) are also available in the library.

VISION FOR NEXT FIVE YEARS

The Department of Geology, University of Jammu, Jammu aims to become one of the pioneer institutions in the country by imparting quality education and research of international standard in Geology. Being one of the oldest departments in the country, it is an added responsibility on the department to create awareness in the society about the subject. In order to achieve the goal, the department proposes following programs in the next five years

- To keep pace with academic developments at global level, there is a dire need to diversify and introduce job-oriented courses in the PG programme.

- M.Sc. Applied geology be introduced as per NEP 2020 in phased manner to meet the requirements of the society and the country

- The department realizes the demand of time to expose students to the latest techniques in geology. In this regard the department has already signed MOU with University college London to impart training to students under short programs and another MOU is in process with Durham University. Efforts are being made to develop more MOU with industries and institutions for training of the students.

- In order to generate own resources, department plans to offer some self-financing job-oriented courses such as Petroleum Geology. In addition, consultancies may be undertaken by the department to generate funds.

- On the research front, the department would like to focus on resolving geological problems of Jammu Himalaya in particular and Western Himalaya in general. In this connection, the department has received financial assistance programmes SAP and FIST from UGC and DST, respectively.

- The department also aims to create awareness about the subject to the society. For this the department plans to open up its well-equipped museum for public and organize popular lectures, seminars and exhibitions. In addition, the department plans to host its own web site for global access.

OBJECTIVES/MISSIONS

The primary objective is to produce quality students / researchers

- To explore the natural resources of Jammu and Kashmir state for its sustainable development.
- To undertake outreach activities for creating awareness among the masses about natural hazards and their mitigation.
- To disseminate scientific knowledge among the public through exhibits.
- To undertake research in front line areas of Earth Sciences.

RESEARCH PROJECTS (Since 2001)

S. No.	Name of P.I./Co P.I.	Title	Funding Agency	Amount	Period
1	B.L Dhar & S.K Pandita (Co-P1)	Establishment of broadband seismograph station to monitor seismic activity	DST	26,48,717.00	2001-2004
2	R.K Ganjoo (Co-P1)	Dentification status mapping of suru valley Zanskar, Ladakh	SAC-ISRO	5,00,000.00	2002-2004
3	G.M Bhat	Geoenvironmental evaluation of landslide! slope failure hazards along Udhampur- Ramban sector of National Highway KNHIA), NW Himalaya	GBPI-HED	5,50,000.00	2002-2005
4	A.S Jasrotia	Evaluation of groundwater potential zones using remote sensing and GIS techniques in the hilly terrains of Devak-Rui watershed, Jammu District, J&K state	ISRO	11,69,000.00	2002-2005
5	P.K Srivastava	Geochemical, fluid inclusion and isotopic studies of Chamba and Panthal magnesite deposits, H.P and J&K	DST	19,92,620.00	2002-2005
6	U.K Sharma (Now in DST)	Ordovician-Silurian bio events in Himalaya (fast track)	DST	9,60,000.00	2002-2005
7	G.V.R Prasad (Now in Delhi University)	Taxonomic diversity and biogeographic affinities of Cretaceous micro vertebrate fauna of India	DST- DAAD	3,45,000.00	2002
8	G.V.R Prasad (Now in DU)	Mesozoic mammalian faunal changes: the fossil record from India	DST	24,44,000.00	2004

9	Y.R Singh (Now in Manipur University)	Palyno-stratigraphy and hydrocarbon potential evaluation of the lower tertiary successions of Jammu region, J&K	DST	8,09,000.00	2005
10	R.K Ganjoo	Inter and intra annual seasonal variability and its effect on snow cover: a case study of Kangriz glacier basin, Zanskar ranges, Ladakh (J&K)	DST	55,00,000.00	2005
11	R.K Ganjoo (Co-P1)	Glacier morphology and Quaternary history of Durung Drung glacier, Zanskar, Ladakh (J&K)	DST	40,00,000.00	2005
12	Sukh chain Sharma (Now in College)	Ore fluid evolution in the Tosham Sn+Co+Cu deposits, Bhiwani district, Haryana (fast track)	DST	13,38,000.00	2005
13	A.S Jasrotia	Establishing the natural resources digital database district Centre at Jammu and creation of an integrated database for development planning	DST	35,67,000.00	2006
14	A.S Jasrotia	Groundwater Prospect Mapping Work of Rajiv Gandhi Drinking Water Mission (RGNDWM) Phase-III of Jammu district	NRSA	6,00,000.00	2007
15	R.K Ganjoo	Snow and glacier study of Nubra - Shyok valley including Stachen glacier	SAC-ISRO	19,00,000.00	2007-2009
16	G.M Bhat & S. K Pandita (Co-P1)	Geotechnical Investigations and Instrumentation of Panthial and Peera Landslides along NHIA, J&K	DST	54,00,000.00	2007-2010
17	M.A Malik (Co-P1)	Crustal Deformation Studies in Kashmir Himalaya Using GPS Aided Geodetic Technique	DST	66,35,200.00	2007-2010
18	G.M Bhat & S.K Pandita (Co-P1)	Setting up of Additional Seismological Observatories with V-Sat Networking in Jammu Region, J&K State	MOES	75,57,360.00	2007-2010
19	G.M Bhat	Hydrocarbon Prospectivity in Sirban Limestone of Jammu Region (India)	ENI, Milan	18,00,000.00 (30000 Euros)	2008
20	R.K Ganjoo	Mass balance study, snout monitoring and Quaternary history of Macher glacier Kashmir Himalaya	DST	55,00,000.00	2009
21	Varun Parmar	Continental Jurassic Vertebrate Fauna of India: Biodiversity, Evolution and Intercontinental Affinities	DST	12,30,736	2009-2013
22	S.K Pandita	Mega- and microfloristics of the Permo-Carboniferous sediments of Kashmir region: evolutionary, biostratigraphical, palaeoecological and palaeophytogeographical implications	DST	23,96,000.00	2012
23	P.K. Srivastava	Himalayan Cryosphere Science and Society	DST	1,58,54000.00	2013-2018
24	G.M. Bhat	Permian-Triassic climatic and environmental extremes and biotic response	International Collobration	IGCP-630 Funds with Chen Zhang – China	2014-2018
25	S.K. Pandita & Yudhbir Singh	Active Fault study around Kishtwar area, J&K	MOeS	51,39,916.00	2014-2018
26	R.K. Ganjoo / P.K. Srivastava	Himalayan Cryosphere Science and Society- Inter University Consortium	DST	435, 21,000.00	2015-2018
27	Som Nath	Reconstruction of Paleoclimate and Depositional Environment across Plio - Pleistocene Succession of Upper	SERB	26,74,000.00	2015-2019

		Siwalik Subgroup, J&K: Using Stable Isotopic and Sedimentary Proxies			
28	G.M Bhat & Yudhbir Singh	Seismotectonic analysis of Jammu region and its adjoining areas	MOES	206, 96,240.00	2016-2020
29	G.M Bhat & Dr. Yudhbir Singh	Seismic hazard assessment in the Kashmir Himalaya using geological, seismological and geodetic data	MOES	151, 76, 800.00 (JU Component)	2016-2020
30	G.M Bhat, S.K Pandita & Yudhbir Singh	Crustal deformation studies and active fault mapping in Jammu and Kashmir region	MOES	153, 28, 400.00	2016-2020
31	Varun Parmar	Biodiversity and Paleobiogeography of the microbiota from Deccan Infra and Inter-trappean Beds of Malwa Plateau, Central India	SERB	37, 36,000.00	2018-22
32	Som Nath	Delineation of new fossil yielding sites in The Upper Siwalik Subgroup of Jammu Province, J&K, India	RUSA-2 University of Jammu	1,00,000.00	2019
33	Yudhbir Singh	Identification of Active fault segements vis-a-vis potential Landslides along Mughal Road, J&K, A sustainable development perspective	JKST & IC	6,39,000.00	2021-23
34	S.K. Pandita	Geomorphic and Palaeo-seismic studies along the Kishtwar strike-strike slip fault, Kishtwar Region	JKST &IC	6,40,000.00	2021-23
35	Varun Parmar	Palaeontological Investigations of Lower Siwalik Subgroup of Jammu Province.	JU Quality Assurance Fund	2,00,000	01/2013
36	S.K. Pandita	Strategizing a sustainable development model through resource mapping for socio economic empowerment of the society in the Tawi River catchment area.	TDRS	7,10,000.00	2024-26

DEPARTMENT OF GEOLOGY, UNIVERSITY OF JAMMU
Course Framework of Two Years Postgraduate Programme in Applied Geology
under National Education Policy (NEP) 2020

Semester I (for sessions December 2025, 2026, 2027)				
Course Code	**Course Title**	**Credit**	**Marks**	**Total Credits**
P2AGTC101	Applied Stratigraphy	4	100	24
P2AGTC102	Structural Geology and Geotectonics	4	100	
P2AGTC103	Igneous Petrology & Geochemistry	4	100	
P2AGTC104	Applied Hydrogeology	4	100	
P2AGTC105	Applied Mineralogy	2	50	
P2AGPC106	Practical (101, 102, 103, 104, 105)	4	100	
P2AGRC107	Weekend Geological Field Work (5-7 days)	2	50	
Semester II (for sessions May 2026, 2027, 2028)				
P2AGTC201	Sedimentology: Processes & Petrology	4	100	24
P2AGTC202	Applied Palaeontology	4	100	
P2AGTC203	Geospatial Techniques	4	100	
P2AGTC204	Metamorphic Petrology	2	50	
P2AGTC205	Geo-exploration & Mining Geology	4	100	
P2AGTC206	Earth Surface Features & Processes	2	50	
P2AGPC207	Practical (201, 202, 203, 204, 205)	4	100	
P2AGVC251	Field and/or Laboratory work in Geology	4	100	Mandatory for students who intend to exit after 1 Year*
*Student existing after successfully completing 1 year with Vocational Course will be awarded **PG Diploma in Geology**				
Semester III (for sessions December 2026, 2027, 2028)				
P2AGTC301	Applied Micropalaeontology and Oceanography	4	100	24
P2AGTC302	Ore Geology	4	100	
P2AGTC303	Sedimentary Basin Analysis & Hydrocarbon Resources	4	100	
P2AGTC304	Geotechnical Engineering	4	100	
P2AGTC305	Application of Remote Sensing & GIS in Geology	2	50	
P2AGPC306	Practical (301, 302, 303, 304,305)	4	100	
P2AGRC307	Geological Field Work (Outstation 10-15 days)	2	50	
P2AGMO351	MOOC/SWAYAM Course	4	100	4
Semester IV (for sessions May 2027, 2028, 2029)				
P2AGTC401	Quaternary Geology and Palaeoclimate	4	100	24
P2AGTC402	Natural Hazards & Disaster Management	2	50	
P2AGTE403	Gemology *Select any one*	2	50	
P2AGTE404	Glaciology	2	50	
P2AGTE405	Earthquake Geology	2	50	
P2AGRC406	Dissertation	16	400	
Total credits to be earned by the student				**100 (96+4)**

Scheme of Examination

A) Scheme of Examination: (For 2 credits course having Four Units)

The student shall be continuously evaluated during the conduct of each course on the basis of his/her performance as follows:

MCQ on LMS + Subjective Test	**Syllabus to be cover In the examination**	**Time allotted for the examination**	**Weightage (Marks)**
Test I (after 30 days)	25%	1 hour	5+5
Test II (after 60 days)	26 to 50%	1 hour	5+5
Theory	Syllabus to be covere in the examination	Time allotted for the examination	Weightage (Marks)
Major test (after 90 days)	100%	2 ½ hours	30
Total			50

Test I and Test II
The subjective Test of Test I and Test II would consist of three short answer type questions. Students are required to answer two questions (5 Marks). No preparatory holidays shall be provided for the Test I and Test II. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 7 out of 20 will be eligible to re-appear in the Test I and/ or Test II only once.

Major Test
The Major test will comprise of two sections, Section–A and Section–B. Section-A will have one compulsory question comprising of 10 parts (minimum 02 from each unit) of 01 mark each. Section-B will have 04 questions of 10 marks each to be set from the last two units (02 from each unit). Students are required to attempt 01 question from each unit of section B. In major test there should not be gap of more than one day in between two tests.

B) Scheme of Examination: (for 04 credit course having Five Units)
The students shall be continuously evaluated during the conduct of each course on the basis of his/ her performance as follows

MCQ on LMS+ Subjective Test	**Syllabus to be covered In the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Test I (after 30 days)	20%	1 hour	10+10
Test II(after 60 days)	21 to 40%	1 hour	10+10
Theory	Syllabus to be covered in examination	Time allotted for the examination	%Weightage (Marks)
Major test (after 90 days)	100%	3 hours	60
Total			100

Test I and Test II
The subjective Test of Test I and Test II would consist of three short answer type questions (05 marks each). Students are required to answer two questions. No preparatory holidays shall be provided for the Test I and Test II. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test
The Major test will comprise of two sections, Section–A and Section-B. Section-A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each. Section-B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). Students are required to attempt 01 question from each unit of section B. In major test there should not be a gap of more than two days in between two tests.

C) Practical 04 Credits

	Time allotted for examination	%Weightage (Marks)		
Midterm appraisal	4 hours	25%		
External examination	4 hours	75%	50%	Exam
			25%	Viva-Voce
Total				100

External Practical Research (thesis/ project/ dissertation) Examination
External Practical / Research examination shall be conducted by Board of Examiners consisting of Head of the Department, one / two Senior Professors of concerned department, concerned teacher and outside expert to be appointed by the Vice Chancellor out of the panel to be provided by the Head of the department who shall evaluate / assess final practical performance / dissertation of the students.

Note:-
However, for evaluation of thesis / project / dissertation concerned Board of Studies (BoS) has the flexibility to change the pattern of evaluation.

Detailed Syllabus

SEMESTER - I

Course Code: P2AGTC101 **Title: Applied Stratigraphy**
Credits: 4 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2025, Dec. 2026 & Dec. 2027)

Course Objectives: To impart working knowledge of stratigraphic principle and methods, stratigraphic boundaries, stratigraphic facies analysis and depositional environment, basic concept, types of stratigraphic units and their application in geology; distribution of Precambrian, Paleozoic, Mesozoic, Cainozoic and Quaternary rock successions, fauna and flora of India.

Course Outcomes: After completion of course the students will be able to

- Identified the stratigraphic outcrops in the field at regional and global level
- Interpreted the depositional environment and geologic setting of the area
- Analyzed paleocurrent direction, calculated the age, correlated the rock strata, mark the position of strata and sequences, etc.

Unit 1: Stratigraphic Principles and Codes of Nomenclature

1.1. Stratigraphy definition and Procedures; Procedures for establishing and revising stratigraphic units; Naming of Stratigraphic Units; Publications; codes of stratigraphic nomenclature

1.2. Principles of Stratigraphy: Walther's law, order of superposition; Principle of Uniformitarian's; Principle of faunal succession; principle of catastrophic event; principle of homotaxis, contemporaneous; Synchronous beds; lithology; principle of original horizontality; principle of cross-cutting; inclusion, incomplete records; base level; accommodation; preservational potential and cyclicity.

1.3. Stratigraphic Correlation: Lithostratigraphy Correlation - continuity of contacts between units; lithologic similarity; Stratigraphic position of a unit in sequence of strata; well logs; Structural characteristics; Biostratigraphy Correlation-Stages of evolution of fauna; Guide fossil; Fauna resemblances; position in biostratigraphic sequence; Chronostratigraphy correlation- Quantitative chronology; eustatic changes in sea level;

1.4. Stratigraphic Classification: lithostratigraphy; biostratigraphy; chronostratigraphy; Geological time scale and earth's climate History,

Unit 2: Stratigraphy Events/boundaries

2.1. Precambrian - Cambrian boundary: Identification in India and global level, age, biota extinction and causes.
2.2. Permo-Triassic boundary: Identification in India and global level, age, biota extinction and causes.
2.3. Cretaceous-Tertiary boundary: identification in India and global level, age, biota extinction and causes.
2.4. Neogene-Quaternary boundary: identification in India and global level, age, biotic extinction and causes.

Unit 3: Stratigraphy Types and Applications

3.1. Sequence Stratigraphy and Radiometric Stratigraphy: concept and applications.
3.2. Magnetostratigraphy, Ichnostratigraphy and Chemostratigraphy: concept and applications.
3.3. Facies Stratigraphy, Isotopic Stratigraphy and Cyclostratigraphy: concept and applications.
3.4. Archaeology Stratigraphy and Extraterrestrial Stratigraphy: concept and applications.

Unit4: Precambrian Stratigraphy

4.1. Precambrian major belts of peninsular India
4.2 Archean stratigraphy of Peninsular India (Karnataka and Madhya Pradesh group; Rajasthan)
4.3 Proterozoic Stratigraphy of Peninsular India (Cuddapah and Vindhyan group)
4.4 Extra Peninsular India (lesser Himalaya - Chandpur, Mandhali, Nagthat, Jaunsar, Blaini, Infra-Krol, Krol and Shali and higher Himalaya-Vaikrita, Haimanta, Salkhala, Dogra Slate, Jutogh, Chail, Shimla Slate and Darjeeling Formations)

Unit 5. Palaeozoic, Mesozoic and Cenozoic Stratigraphy

5.1 Palaeozoic stratigraphy: Distribution and Correlation of Palaeozoic of Peninsular and extra peninsular India and their tectonic history during Paleozoic times.
5.2 Mesozoic Stratigraphy: Distribution, Classification, depositional characteristics, fauna, and flora of Triassic of Spiti, Jurassic of Kutch and Cretaceous of Trichnapolly systems of India; Mesozoic Transgression and Regressions. Field characters and age of Deccan traps, concept of Gondwanaland and global distribution of Gondwana rocks
5.3. Palaeogene Stratigraphy: Distribution, Classification, depositional characteristics, fauna, and flora of the Palaeogene, Himalayan Ophiolite mélanges and their significance.
5.4 Neogene Stratigraphy: Distribution, Classification, depositional characteristics, fauna and flora of the Siwalik and Karewas Deposits. Quaternary Stratigraphy: Distribution of the Quaternary sediments in India

Books Recommended

1. Weller, J. Marvin. 1959. Stratigraphic Principles and Practice. Harper and Brothers Publishers; New York.
2. Dubbar, C Owen & Rodger, John. 1957. Principles of Stratigraphy. New York, Wiley.
3. Hedberg, Hollis D. 1976. International Stratigraphic Guide.
4. Michael A. Murphy & Amos Salvador. 1999. International Stratigraphic Guide - An abridged version. Episodes.
5. Code of Stratigraphic Nomenclature, 1971. GSI Publications.
6. Krishnan, M.S. 1943.Geology of India and Burma. CBS Publisher and Distributer Pvt. Limited.
7. Pasco, E.H. 1965.Manual of Geology of India & Burma, Vol. I-III. Manager of Publications
8. Wadia, D.N. 1919.Geology of India. TATA McGraw-Hills
9. Ravindra Kumar.1985. Fundamentals of Historical Geology & Stratigraphy of India. Wiley Eastern Limited.
10. Naqvi, S. M. & Rogers, J. J. W. 1987.Precambrian Geology of India. Oxford University Press.
11. Pichamuthu, C.S. 1985. Archean Geology. Cambridge University Press.
12. Rama Krishna, M. & Vadhyanathan, R. 2008. Stratigraphy Vol I - II (2008). Geological Society of India.
13. Shah, S. K. 2018. Historical Geology. Scientific Publishers.
14. John W. Harbauch & Danil F. Merriam. 1968. Computer Application in Stratigraphic Analysis. Wiley.
15. Octavian Catuneanu. 2022. Principles of Sequence Stratigraphy. Elsevier
16. Jaitely A.K., Singh, A.D., Pandey, B. & Nath, S. 2011.Palaeontology and Stratigraphy: Basics to Applications. Muddrak, Varanasi.
17. Odin, G.S. 1982. Numerical Dating in Stratigraphy. John Wiley & sons
18. Michel E. Brookfield.2016. Principles of Stratigraphy. Wiley Blackwell Publisher
19. Robert E. Sheriff. 1980. Seismic Stratigraphy. IHRDC Publisher, Boston.
20. Robert L. Brenner & Trimonthy R. Mc Hargue. 1988. Prentice Hall.
21. Key Papers on the major boundaries (1988) by Radhakrishnan & Ramakrishna, Shah, Sahni & Ranga Rao.
22. Miall A.D. 1965. The Geology of Stratigraphic Sequence. Springer.
23. Sahu. B.K. 2023. Stratigraphy and palaeontology. Wisdom Press.
24. Gary Nichols (2012. Sedimentology and Stratigraphy. Willy-Blackwell.

Course No.: P2AGTC102 **Title: Structural Geology and Geotectonics**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2025, Dec. 2026 & Dec. 2027)

Course Objectives: To develop a comprehensive understanding of rock deformation processes and the structural fats of Earth's crust.

Course Outcomes: At the completion of this course the students shall be able to

- Understand the tectonic settings through rock mechanics, micro and macro structural features
- Learn various techniques for plotting structural data in geological maps

UNIT I - Fundamentals of Structural Geology

1.1. Concept of Stress and Strain, Stress in homogeneous and inhomogeneous rocks.
1.2. Basics of Rheology and Mechanisms of Rock deformation
1.3. Techniques of Strain measurement, common types of finite strain ellipsoids.
1.4. Mohr diagram, and Wellman diagram.

UNIT II Structures formed in extensional, compressional, brittle and plastic regimes

2.1 Mechanism of folding and internal strain accommodation, Geometry of folds and their classification schemes (Dip isogons and superimposed folding).
2.2. Mechanism of faulting, geometry and analysis of fractures, joints and faults.
2.3 Types of Faults: Normal Fault, Reverse fault, Strike-slip fault.
2.4 Geometry and analyses of brittle-ductile and ductile shear zones.

UNIT III Interior of Earth and Plate Movements

3.1. Seismic investigations of Earth's interior, wave's velocity, velocity curves, density distribution, elastic properties, pressure and temperature within the earth.
3.2. Plate Margins: seismicity, structure and plate motions in constructive, destructive and conservative plate margins.
3.3. Concept of continental drift, Evidences of sea floor spreading, causes of plate motion, oceanic ridges, trenches, and benioff zone.
3.4. Composition of the earth's crust and upper mantle and crust-mantle relationship.

UNIT IV Microstructures and Tectonic Significance

4.1. Kinematics and Palaeostress analysis.
4.2. Time relationship between deformation and recrystallization.
4.3. Rock Fabric: Planar and Linear fabrics, terminology, development and significance.
4.4. Common types of finite strain ellipsoids, L-tectonics, S-tectonic and L-S tectonics.

UNIT-V Himalayan Tectonics
5.1. Himalayan Tectonics: sedimentation, closing of continents, shifting of depositional basins.
5.2. Subduction tectonics: Drift and subduction of the Indian Plate, Andaman subduction zone and Makran subduction.
5.3. Himalayan orogeny and tectonic models: critical taper wedge model, rolling hinge model.
5.4. Tectonics of fold thrust belt, and foreland basin (fault propagated folds, fault bend folds).

Books Recommended

1. Badgley, P.C. Structure and Tectonics
2. Ramsay, J.G. Folding and fracturing of Rocks
3. Hobbs, B., Means W. & William, P. An Outline of Structural Geology iv.
4. Gosh, S.K. Structural Geology: Fundamentals & Modern Developments
5. Dennis, J.G. Structural Geology: An Introduction
6. Park, R. G. Foundations of Structural Geology
7. Davis, G H Structural Geology of Rocks & Regions
8. Jain, A K Structural Geology, 2014
9. Passchier&Trouw Microtectonics
10. Twiss & Moore Structural Geology
11. Ramsay, J.G. and Martin, I. Techniques in Structural Geology, vol. I, II
12. Condie, K C Plate Tectonics and Crustal Evolution
13. Cox, A Plate Tectonics and Geomagnetic Reversals
14. Balanssov Basic problems in Geotectonics
15. Wadia, D N Geology of India
16. Gansser, A Geology of the Himalaya
17. Valdiya, K S Aspects of Geotectonics
18. Fossen Haakon Structural Geology
19. Mitra and Marshak Structural Geology and Tectonics
20. Rowland Structural Analysis and Synthesis
21. Valdiya, K S The Making of India

Course No.: P2AGTC103 **Title: Igneous Petrology and Geochemistry**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2025, Dec. 2026 & Dec. 2027)

Course Objectives: The Course aims to make to the students well-versed with the strength of Igneous Petrology Theory applications.

Course Outcomes:
- The students will develop skills, to identifying a wide range of igneous rocks
- The students will understand the processes of formation of the rocks.
- The students will learn to identify the corresponding geological settings.
- The student can apply the knowledge to understand the magmatic evolution

UNIT-I
1.1 Mantle as heat engine, nucleation and crystal growth, igneous rock series.
1.2 Magma and its generation; Melting Depth, mantle material, partial melting of the peridotitic mantle and magma generation in continental crust
1.3 Magmatic Differentiation (open and closed systems) and assimilation, Hybridization, magma storage, ascent and emplacement, field relations of intrusions
1.4 Phase rule, Phase equilibrium studies of binary system with eutectic (Di-An), peritectic (Fo-Silica) and solid solution relation (Ab-An, Orthoclase-Albite) and ternary system (Di-Ab-An) and theirtheir application in describing textures and petrogenesis of various rock- types.

UNIT-II
2.1 Classification schemes of igneous rocks, IUGS classification of plutonic, hypabyssal and volcanic rocks,
2.2 Irvine-Baragar classification of volcanic rocks, classification of basalt: IUGS, Kuno, Yoder and Tilley, Macdonald and Katsura, Chayes, Pearce and Cann.
2.3 Mid Ocean Ridge Basalt (MORB) and its global correlation.

2.4 Large Igneous Provinces, mantle plumes and related magmatism. General idea on layered complex

UNIT-III

3.1 Petrogenesis and tectonic setting of major igneous rock types and suites: Ultramafic rocks, Komatiite, Ophiolites, Basalt and Anorthosite.
3.2 Petrogenesis and tectonic setting of Lamprophyres and Kimberlite.
3.3 Petrogenesis and tectonic setting of alkaline rocks and Carbonatite.
3.4 Petrogenesis and tectonic setting of Tonalite-Trondhjemite-Granodiorite (TTG), Granitoids and its derivatives and pegmatites.

UNIT-IV

4.1 Meteorites: Mineralogy and Classification. Meteorites: definition, age, importance of study; classification and its basis, mineralogical characteristics and contrast with terrestrial mineralogy, broad chemical characteristics, brief outline on origin
4.2 Origin of chemical elements and stellar evolution, Distribution of elements in core, mantle, crust. Geochemical differentiation of primordial earth.
4.3 Geochemical classification of elements:Washington's, Goldschmidt's, Kuhn and Ritmann
4.4 Significance of crystal chemistry in geochemistry, isomorphism and diadochy, camouflage, capturing and admission of trace elements. Partition coefficients

UNIT-V

5.1 Behaviour of major and trace during magmatic melting and crystallization and their application in petrogenesis and as tectonic discriminannts.
5.2 Rare earth geochemistry, general geochemical properties of REE's and their abundance and mobility in crust.
5.3 Radiogenic isotopes in geochronology and petrogenesis: Rb-Sr, Sm-Nd, U-Pb isotopic systems.
5.4 Stable isotopes: nature, abundance and fractionation. Application of stable isotopes in geological processes.

Books Recommended

1. Phillpotts, A.R. (1994) Principles of Igneous and Metamorphic Petrology, Prentice Hall of India.
2. Winter, J. D. (2014) Igneous and Metamorphic Petrology, Pearson Education Limited, Edinburg.
3. Best, M. G. (2003) Igneous and Metamorphic Petrology, 2nd Ed. Blackwell.
4. Bose, M.K. (1997) Igneous Petrology, World Press, Kolkata.
5. Cox, K. G., Bell, J. D. and Pankhurst, R. J. (1979) The Interpretation of Igneous Rocks, UnwinHyman.
6. McBirney, A. R. (1993) Igneous petrology. Jones & Bartlet Publication.
7. Allegre, C.J. and Michard, G. (1974) Introduction to Geochemistry, Reidel, Holland.
8. Evans, R.C. (1964) Introduction to Crystal Chemistry, Cambridge Univ. Press.
9. Faure, G. (1998) Principles and applications of geochemistry, 2nd Edn., Prentice Hall, New Jersy, 593p.
10. Faure, G. (1986) Principles of Isotope Geology, 2nd Ed. John Wiley.
11. Krauskopf, K.B. (1967) Introduction to Geochemistry, McGraw Hill.
12. Mason, B. and Moore, C.B. (1991) Introduction to Geochemistry, Wiley Eastern.
13. Sen, Gautam(2014) Petrology, Principles and practice

Course Code: P2AGTC104 **Title: Applied Hydrogeology**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2025, Dec. 2026 & Dec. 2027)

Course Objectives: The course aims to provide students with a comprehensive understanding of the hydrologic cycle, water balance, and processes governing surface and groundwater flow. It equips the students with analytical tools and techniques for hydrologic data analysis, modeling, and water resource management. The course also emphasizes practical applications in flood forecasting, watershed management, and sustainable groundwater utilization.

Course Outcomes: At the completion of this course the students shall be able to

- Understand and apply fundamental and advanced concepts of hydrological processes, including precipitation, infiltration, runoff, groundwater flow, and watershed modeling
- Will develop skills in hydrological data analysis, use of hydrological models and water resource management

Unit- I: Fundamentals of Hydrology

1.1. Introduction to Hydrology: Hydrology and Its Importance, Hydrologic cycle, Origin and classification of water, Precipitation, infiltration, evapotranspiration, runoff, Types and measurement of precipitation.
1.2. Catchment storage concept, Excess rainfall, Direct runoff, Overland flow, Hydrological data sources and networks (IMD, CWC, CGWB), Rainfall-runoff relationships; hyetograph and hydrograph analysis.
1.3. Watershed characteristics and delineation, water balance studies and their applications.
1.4. Stream flow measurement: stage-discharge relationships, current meter, float method.

Unit- II: Surface Water Hydrology

2.1. Stream Hydrographs: Baseflow recession, storm hydrographs, gaining and loosing stream, measurement and representation of stream flow.
2.2. Flood hydrology: types, causes, frequency analysis, flood routing.
2.3. Linear system theory, Unit Hydrograph, Direct runoff hydrograph, S-Hydrograph, Unit hydrographs of different durations, Instantaneous unit hydrograph, Synthetic unit hydrograph.
2.4. Unit hydrographs for ungauged catchments, concept of Catchment modelling, Effect of rainfall intensity and duration on hydrograph

Unit- III: Fundamentals of Groundwater

3.1. Occurrence and distribution of groundwater, Aquifer types: confined, unconfined, perched, leaky aquifers.
3.2. Hydrological properties of rock-formations, Porosity, permeability, specific yield, specific retention, Hydrostratigraphic units, water table contour maps and flow net analysis.
3.3. Groundwater movement: Darcy's law, hydraulic conductivity, Unsaturated flow.
3.4. Groundwater quality: major ions, EC, pH, TDS, water quality standards (WHO/BIS), graphical presentation of water quality data.

Unit- IV: Exploration and Management of Groundwater

4.1. Groundwater exploration techniques: Subsurface geophysical method, well logging techniques for delineating aquifer thickness and estimation of groundwater quality; electric radiational both natural and induced caliper and temperature logs.
4.2. Different drilling methods used in the construction of water wells; Shallow, deep penetrating and non-penetrating types, various groundwater structures.

4.3. Groundwater balance and budgeting, Fracture trace analysis, pumping test methods, interpretation of data (Theis, Cooper-Jacob).
4.4. Artificial recharge methods and managed aquifer recharge (MAR), Water Resource Management Pricing of Water, Sustainable Development of Water.

Unit-V: Applied Aspects and Modelling in Hydrology

5.1. Basic introduction to hydrological and groundwater models (e.g., SWAT, MODFLOW).
5.2. Groundwater contamination: sources, transport, and remediation techniques.
5.3. Fundamentals of hydrologic design, Design storm, Design flood, Design flows, Storm sewer design.
5.4. Simulating Design flows, flood plain analysis, flood control reservoir design, flood forecasting, Design for water use.

Recommended Books:

1. Todd, D.K. & Mays, L.W. (2005). Groundwater Hydrology. Wiley.
2. Karanth, K.R. (1987). Groundwater Assessment, Development and Management. Tata Mc Graw Hill.
3. Raghunath, H.M. (2007). Hydrology: Principles, Analysis and Design. New Age International.
4. Subramanya, K. (2017). Engineering Hydrology. McGraw-Hill.
5. Singh, V.P. (1992). Elementary Hydrology. Prentice Hall.
6. Alley, W\.M. (1993). Regional Ground-Water Quality. Van Nostr and Reinhold.
7. Chow, V.T. (1964): Handbook of Applied Hydrology. New York: McGraw Hill Book Co.
8. Charles R. Fitts (2013): Groundwater Science, Academic press.
9. Fetter C.W (2001): Prentice Hall International (UK) Limited, London.

Course No.: P2AGTC105 **Title: Applied Mineralogy**
Credits: 02 **Maximum Marks: 50**
Duration of Examination: 2 ½ hours **(Minor I-10, Minor II 10, Major 30)**

(Syllabus for the examination to be held in Dec. 2025, Dec. 2026 & Dec. 2027)

Course Objectives: This course offers the broader understanding to the field of mineralogy by imparting the basic knowledge about the rock forming minerals, their formation, complexity, associations, identification and allied technical contexts. The course also provides an introduction to mineral characterization techniques and highlights the industrial applications of key minerals.

Course Outcomes: After completing this course, students will be able to:

- Understand the fundamental properties, structures, and classifications of minerals and crystals.
- Interpret light-matter interactions and identify minerals using optical techniques.
- Apply principles of optical mineralogy to distinguish uniaxial and biaxial minerals.
- Classify non-silicate and silicate mineral groups based on structure, properties, and paragenesis.
- Utilize advanced analytical tools (XRD, XRF, SEM etc.) for mineral identification and characterization.
- Carry out analytical work on rock/ mineral samples, thin sections and powdered materials.

UNIT I – Optical Mineralogy

1.1 Light-matter interaction: isotropic vs. anisotropic minerals. Optical phenomena—color, refraction, reflection, TIR, refractive index. Light behavior—phase, interference, colors, retardation, resolution.
1.2 Polarization: methods, uses. Polarizing microscope and accessories.
1.3 Extinction: types, causes, measurement, uses. Refractive index determination.
1.4 Optical Indicatrix: uniaxial and biaxial—construction and applications. Interference figures (Uniaxial & Biaxial): types, parts, formation, and uses. Optic angle (2V) measurement;

UNIT II – Descriptive mineralogy

2.1 Minerals as solid solutions; Principles governing solid solution mineral chemistry phenomena.
2.2 Structure of silicate minerals. Bearing of structure on certain properties of minerals
2.3 Classification, features, and paragenesis of Oxides & hydroxides, Sulfates & sulfides, Carbonates & phosphates and atomic minerals
2.3 Brief idea on the internal structure of Pyroxene, Amphibole and Mica (with relevant classification schemes) and site- occupancy of cations.
2.4 Mica & Clays: structure, classification, paragenesis.

UNIT III – Silicate Minerals and Transformations

3.1 Olivine: Brief structural characters, classification, anti-ordering in olivine, olivine- spinel transitions and its geodynamic significance.
3.2 Spinel Group: Different types of spinels and their internal structures.
3.3 Feldspar Group : internal structure, Alkali Feldspar, Plagioclase Feldspar and ternary feldspar, proportion of Al- occupancy in T sites in KAlSi3O8; degree of ordering, 2V as an indicator of ordering in K- feldspar, polymorphism of $NaAlSi_3O_8$, ordering paths in albite, structural states of plagioclase, obliquity of K- feldspar
3.4 Nepheline: Constitution of Nepheline, compositional non- stoichiometry, nephelines of volcanic and plutonic /metamorphic origin, nature of Al- Si ordering, vacant site from chemical analysis of nepheline.

UNIT IV – Mineralogical Techniques

4.1 Principles of X- ray powder methods, Bragg Equation and its application, different types of bonding, co-ordination principle and co-ordination numbers,
4.2 X–ray camera: diffractrogram, procedure for identification of minerals from x-ray powder diagram, use of internal standards.
4.3 Application of SEM, TEM and EPMA in mineral characterization.
4.4 Fundamentals of Crystal Field Theory, concept of stabilization energy, Application of crystal field Theory in determining mineral structure.

Books Recommended

1. Mukherjee, S. — Applied mineralogy: Applications in Industry & Environment.
2. Nesse, W.D. — Introduction to Mineralogy
3. Putnis A. — An introduction to mineral sciences
4. Whalstrom, E. E. — Optical Crystallography
5. Nesse, W.D. — Introduction to Optical Mineralogy
6. Dana, E.S . — A Textbook of Mineralogy
7. Mitra, S. — Fundamentals of Optics Spectroscopic & X-ray Mineralogy
8. Ehelrs, E.G. — Optical Mineralogy
9. Kerr, P.F. — Optical Mineralogy
10. Naidu, P.R.J . — Optical Mineralogy
11. Philips, W.R. — Mineral Optics
12. Sholley, P. — Manual of Optical Mineralogy
13. Winchel, A.N — Elements of Optical Mineralogy
14. Mckie, D. &Mckie, C. — Crystalline Solids
15. Wolfson M.M. — X-Ray Crystallography
16. Deer, Howie &Zussman. — An introduction to the rock forming minerals
17. Cerreves . — Introduction to mineralogy
18. Berry and Masons. — Mineralogy
19. Kestov . — Mineralogy
20. Batckhtin . — Mineralogy

21. Vema, P K . Optical Mineralogy Ane Book Pvt Ltd. Delhi
22. Sharma, R and Sharma A. Crystallography and Mineralogy: Concepts and Methods GSI

Course Code: P2AGPC106 **Practicals related to Course No.: 101, 102, 103, 104, 105**

P2AGPC101: Practical hand on stratigraphic columns, facies diagrams and correlation charts from field data. Making of fence diagrams from borehole data, calculation of bed thicknesses using trigonometric techniques, development of composite lithologs. Identification and division of lithocolumn into Group, Formation, Members, Beds etc,

P2AGPC102: Geometric methods used to interpret geological structures, completion and interpretation of geological maps, strain analysis, palaeostress analysis

P2AGPC103: Megascopic and microscopic studies of major igneous rock types. CIPW norm calculation. Introduction to software: Sinclass, Petrograph, and GCD kit. Preparation of Solution A and Solution B; determination of various major oxides by titration methods; determination of alkali elements by Flame photometer; determination of elements by UV/VIS spectrophotometer.

P2AGPC104 Rainfall and Stream flow Data Analysis: Plotting hyetographs, hydrographs, flow-duration curves, Water Sampling & Quality Testing*: TDS, pH, EC, hardness, major cations/anions, Aquifer Parameter Estimation : Analysis of pumping test data using Theis and Cooper-Jacob methods.

P2AGPC105 Identification of important rock forming minerals in hand specimen and their physical properties; preparation of thin-section from bulk rock samples; determination of various optical properties and identification of rock forming minerals under polarizing microscope and optic sign determination of uniaxial and biaxial minerals; pleochroic scheme determination of minerals using polarizing microscope; staining technique for identification of carbonate minerals; X-ray diffraction related computations.

Course No P2AGRC107
Weekend Geological Fieldwork **Credits: 2** **Max. Marks: 50**

This course shall comprise of 5-7 day's weekend field work. The students shall have experiential learning on toposheet reading, field mapping techniques, identification of rocks, structures, lithology, stratigraphy etc. At the end the students shall submit a comprehensive field report. The distribution of marks shall be as follows:

Attendance: 10%
Performance during the fieldwork: 20%
Field Report: 60%
Viva-voce at the time of external examination: 10%

SEMESTER - II

Course No.: P2AGTC201 **Title: Sedimentology: Processes & Petrology**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in May 2026, May 2027 & May 2028)

Course Objectives: The course shall help students to understand the processes involved in the formation of sedimentary rocks and their petrogenesis.

Course Outcomes: This course typically explores the fundamental processes responsible for formation of sedimentary rocks, their characteristics, classification and petrogenesis.

UNIT-I Sediments and sediment analysis

1.1 Formation and nature of sediments, formation of sedimentary rocks
1.2 Sediment analysis: grain size (techniques of size analysis, grade-scale, phi-scale;) grain morphology (shape forms, sphericity, roundness; grain fabric).
1.3 Graphical representation, application and uses of grain size data; Textural parameters and their significance
1.4 Indicators of sediment maturity: mineralogy and textures; surface textures and their significance

UNIT-II Sedimentation: sediment transport and deposition

2.1 Fluid motion, forces acting on fluids, basic properties of fluids and flow types
2.2 Streamlines, flow separation, flow regimes
2.3 Sediment transport modes; sediment gravity flow: mud flow, grain flow, liquefied flow, turbidity flow
2.4 Porosity and permeability, pore morphology, effect of texture on porosity and permeability

UNIT-III Sedimentary structures

3.1 Nature and significance of bedding, Graded beds, stability of bedforms
3.2 Primary Sedimentary structures: Formation and significance
3.3 Sole marks: types, mode of formation, significance
3.4 Deformational sedimentary structures and their significance

UNIT- IV Sedimentary rocks: classification & petrology

4.1 Classification and petrogenesis of clastic sedimentary rocks (rudaceous rocks, arenaceous and argillaceous rocks)
4.2 Nomenclature and Classification of carbonate rocks (Folk and Dunham)
4.3 Carbonate rocks and their allochemical and orthochemical constituents, Dolomitization, Dedolomitization
4.4 Diagenesis of sedimentary rocks

UNIT- V Petrogenesis & Depositional Environments

5.1 Petrogenesis of biogenic silica and phosphate deposits
5.2 Petrogenesis of Evaporites
5.3 Heavy minerals and their significance
5.4 Introduction to sedimentary depositional environments

Books Recommended

1. Miall, Andrew D. — Principles of Sedimentary Basin Analysis
2. Lindholm, R. C. — A Practical Approach to Sedimentology
3. Collinson, J. D. & Thompson, D. B. — Sedimentary Structures
4. Reineck, H. E. & Singh, I. B. — Depositional Sedimentary Environments
5. Allen, J.R.L. — Physical processes of Sedimentation
6. Reading, H.G. — Sedimentary Environments
7. Petijohn, F.J. & Potter — Sand and Sandstone
8. Petijohn, F.J — Sedimentary rocks
9. Friedman, M.Gorale& Sanders — Principles of Sedimentology
10. Selley, R.C. — Applied Sedimentology
11. Blatt, Middleton and Murray — Carbonate sediments and their origin
12. Bathurst, R.G.C. — Carbonate sediments and their diagenesis
13. Miall, A D. — Fluvial Depositional System

Course No.: P2AGTC202 **Title: Applied Palaeontology**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in May 2026, 2027, 2028)

Course Objectives: To understand the basic principles of organic evolution and their application in palaeontology and to have an extensive knowledge of evolution and distribution of the important invertebrate, vertebrate, trace and plant fossils and their significance

Course Outcomes: On successful completion of the course the student will be able to

- Know about evolutionary processes, taphonomy and cladistics
- Appreciate the role of climatic and environmental factors in the evolution, extinction and diversification of various taxonomic groups
- Able to analyse the role of plate tectonics in the distribution of varied groups and comprehend the evolution of biota during the northward drift of the Indian plate
- Interpret the significance of fossils in understanding the earth's history and biological evolution
- Apply fossils to decipher climate, ecology and environment of the past

UNIT-I

1.1 Nature of the fossil record – preservation, taphonomy, sampling, and temporal changes
1.2 Evolutionary process and the fossil record - micro and macroevolution, heterochrony
1.3 Hennigian systematics. Fossils, molecular clocks and estimation of divergence time
1.4. Major bio events and the geological time scale / Mass extinctions – patterns, selectivity, timing, periodicity and causes.

UNIT-II

2.1 Echinoderms and trilobites – geological distribution and significance
2.2 Gastropods, ammonoids and cephalopods – geological distribution and significance
2.3 Brachipods and bivalves – geological distribution and significance
2.4 Bryozoans and graptolites – geological distribution and significance

UNIT-III

3.1 Ichnofossils and their application in geological studies
3.2 Key steps in the evolution of plants. Gondwana floras of India and their significance. Application of palaeobotany in palaeoclimatic studies
3.3 General characters of vertebrates and various classes, and their origin
3.4 Fossils and the evolutionary events in the geological history of the vertebrates: evolution of bone and cartilage, jaw and teeth, transition from water to land, development of amniote egg

UNIT-IV

4.1 Rise and fall of dinosaurs, their diversity and thermoregulation
4.2 Origin of birds, *Archaeopteryx*, birds as dinosaurs
4.3 Palaeobiogeography – vicariance and dispersals. Gondwana and Deccan vertebrates of India and their palaeobiogeographic significance
4.4 Palaeogene hyperthermal events and emergence of modern mammalian orders. Indian Palaeogene mammalian record and biogeography

UNIT-V

5.1 Whale evolution as a poster child for macroevolution
5.2 Systematic, phylogeny, and evolution of horse and proboscideans and the climatic implications in their evolution and distribution
5.3 The fossil trail: how we know what we know about human evolution and lithic cultures
5.4 Siwalik mammalian faunal changes and their relation to tectonic and eustatic events. Pleistocene megafaunal extinctions

Recommended Books

1 Morley Davis & Stubblefield, S.J. 1962. Introduction to Palaeontology. T. Murby.
2 Shrock, R.R & Twenhofel, W.H. 1953. Principles of Invertebrate Palaeontology. 2nd edition. McGraw-Hill
3 Black, R.M. 1989. The Elements of Palaentology. Cambridge University Press.
4 Fairbridge & Jablonski 1979. The Encyclopedia of Palaeontology. Dowden, Hutchinson & Ross, Academic Press, Stroudsburg.
5 Babin, C. 1980. Elements of Palaeontology. Wiley–Blackwell.
6 Clarkson, E. K. 2013. Invertebrate Palaeontology and Evolution. Blackwell Science.
7 Raup, D.M. & Stanley, S.M. 1971. Principles of Palaeontology. W. H. Freeman & Co.
8 Lull, R.S. 1917. Organic Evolution. Macmillan, New York.

9 Dodd, J.R. & Stenton, R.J. 1990 Palaeoecology-Concept and Applications. Wiley
10 Frey, R.W. 1975. The study of trace fossils. Springer Nature
11 Bromley, R.G 2016. Trace Fossils. Routledge.
12 Seilachers. A. 2007. Trace Fossils Analysis. Berlin, Heidelberg, New York: Springer-Verlag.Amal Dasgupta 2016. Introduction to Palaeontology. The World press Private Limited.
13 A.E. Romer & T.S. Parsons. 1977. The Vertebrate Body. 5th edition. Saunders, Philadelphia, PA.
14 E.H. Colbert. 1980. Evolution of the Vertebrates – A history of the backboned animals through time. John Wiley & Sons.
15 M.J. Benton & D. Harper. 1997. Basic Palaeontology. Pearson Education Ltd.
16 R.L. Carroll. 1997. Pattern and Processes of Vertebrate Evolution. Cambridge University Press.
17 M. Hildebrand & G.E. Goslow. 2001. Analysis of Vertebrate Structure. John Wiley & Sons, Inc.
18 M.J. Benton. 2005. Vertebrate Palaeontology. Blackwell Science Ltd.
19 D. E. Fastovsky & D. B. Weishampel. 2016. Dinosaurs: a concise natural history. The Johns Hopkins University

Course No.: P2AGTC203 **Title: Geospatial Techniques**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I 20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in May 2026, 2027, 2028)

Course Objectives: Remote Sensing Technology has emerged as an important tool for scientifically managing resources and environment. The technology enhanced our capability of resources exploration, mapping and monitoring on local and global scale. This course has been designed with the objectives to acquaint the students with basic principles of remote sensing, GIS and GPS.

Course Outcomes: On successful completion of the course the students will be able

- To become aware about the fundamental concept of Remote Sensing, interaction of EMR with atmosphere and earth's surface, platforms- aerial and space borne characteristics, satellites and their characteristics.
- Principles of active and passive sensors, sensors types and their characteristics, optical imaging sensors, concept of resolution, steps and elements of image interpretation.
- To understand multidate, multispectral and multiresolution concepts, instruments for visual interpretation.
- To enables the students to learn the basic professional skills pertaining to concept of digital image, digitization of photographic image, image visualization, digital image data formats, image data storage.
- To understand the fundamental concept of Geographical Information Systems (GIS), computer fundamentals for GIS, hardware and software requirements for GIS.
- To understand the basic concepts of Global Positioning System (GPS), its components, working, and applications in different field.
- To broaden the horizon of the students about the digital cartography, its elements and to substantiate the photogrammetry concepts.

UNIT-I Geospatial Technology-concept and overview

1.1 An Overview of geospatial technology, developments of remote sensing, advantages and limitations of remote sensing techniques.
1.2 Define the basic principles of satellite remote sensing: Electromagnetic Radiation (EMR) and electromagnetic spectrum, earth and atmospheric interaction with EMR
1.3 Remote sensing: data resources, platforms and sensors acquisition of remote sensing data.
1.4 Satellite remote sensing, global and Indian space mission. Different satellite explorationprograms and their characteristics: LANDSAT, METEOSAT, SPOT, JERS-I, IRS.

UNIT-II Aerial photography

2.1 Introduction to aerial photography – Basic information and specifications of aerial photographs
2.2 Aerial camera, lens, types of aerial photographs and information records on the aerial photographs. Planning and execution of photographic flights
2.3 Geometry of the aerial photographs, stereoscopic vision and stereoscope. Measurement of the height difference from aerial photographs.
2.4 Recognition of photo-elements and terrain elements like tone, texture, pattern, shape, size; terrain elements like drainage pattern, density, type, landform characteristics, erosion behavior of rock and soil material, vegetation and landuse.

UNIT-III Thermal and Microwave Remote Sensing

3.1 Introduction, TIR region of electro-magnetic spectrum, thermal properties of material.
3.2 Interpretation of thermal (radiant temperature) imagery, interpretation of day and night thermal image, advantage of thermal imagery.
3.3 Introduction, advantage of microwave remote sensing, microwave sensors, radar operating principle.

3.4 Spatial resolution of SLAR system, geometric characteristic of SLAR imagery, transmission characteristic of radar signals, radar return and image characteristic, interpretation of radar image and general application microwave remote sensing.

UNIT-IV Digital Image Processing

4.1 Introduction to digital image processing- concept of digital image, steps in DIP& Image processing systems - hardware and software

4.2 Fundamental of image rectification, definition, principle and procedure, Radiometric & geometric correction of remotely sensed data.

4.3 Image enhancement techniques Contrast enhancement, equalization and densityslicing, Spatial filtering and edge enhancement

4.4 Image classification types - supervised and unsupervised, advantage and limitations

Unit-V Geographical Information System

5.1 Introduction to GIS - definition, concept and history of developments in the field of information systems

5.2 Components of geographical information system (GIS), database structures in raster and vector and its comparison.

5.3 Global Positioning System (GPS) and its segments, observation principle, parameters affecting the accuracy of result, main components of a GPS receiver and GPS application.

5.4 Digital cartography - elements of digital cartography, relation between digital cartography and photogrammetry

Books Recommended

1. Campbell, J.B.2002: Introduction to Remote Sensing. Taylor Publications
2. Drury, S.A., 1987: Image Interpretation in Geology. Allen and Unwin
3. Gupta, R.P.., 1990: Remote Sensing Geology. Springer Verlag
4. Jensen, J.R. 2000: Remote Sensing of the Environment: An Earth Resource Perspective. Prentice Hall.
5. Joseph George, 2003: Fundamentals of Remote Sensing. Universities Press
6. Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.
7. Ram Mohan Rao. 2002: Geographical Information Systems. Rawat Publication.
8. Skidmore A.2002: Environmental Modeling with GIS and Remote Sensing. Taylor and Francis
9. Tar Bernhardsen. Geographical Information Systems. John Wiley.
10. Wise S.2002: GIS Basics. Taylor Publications
11. Sabbins, F.F., 1985: Remote Sensing Principles and interpretation. W.H. Freeman and company
12. Anji Reddy, M. 2004: Geoinformatics for Environmental Management.B.S. Publications
13. Rampal K.K. 1999: Hand book of Aerial Photography and Interpretation. Concept Publication
14. Paul R Wolf 2014; Elements of Photogrammetry
15. Mishra R.P and Ramesh A. 1989: Fundamentals of Cartography. Concept Publishing Company

Course No.: P2AGTC204 **Title: Metamorphic Petrology**
Credits: 02 **Maximum Marks: 50**
Duration of Examination: 2 ½ hours **(Minor I-10, Minor II 10, Major 30)**

(Syllabus for the examination to be held in May 2026, May 2027 & May 2028)

Course Objectives: The Course aims to make to the students well-versed with the strength of Metamorphic Petrology, including different petrogenetic processes involving mineral reactions and equilibrium thermodynamics.

Course Outcomes:

- Students will acquire a comprehensive understanding of metamorphism and types of metamorphic rocks
- Students will learn thermodynamic principles related to metamorphic petrology, applicable to a number of orogenic events in time and space
- Students will be able to estimate Pressure-Temperature conditions of metamorphic rocks especially those formed during orogenesis.

UNIT-I

1.1 The Common minerals of metamorphic rocks, Concept of equilibrium in metamorphic systems; Gibbs phase rule and Mineralogical Phase Rule and their application in simple and complex systems.

1.2 Graphical representation of metamorphic mineral assemblages in different P-T conditions.

1.3 Schreinemakers rules and Petrogenetic grid for metamorphic assemblages in various grades of metamorphism.

1.4 Time relation between phases of deformation and metamorphic crystallization.

UNIT-II

2.1 Metamorphic Isograds and Zones, Concept and classification of metamorphic facies; Facies series

2.2 Description of facies of low pressure with special reference to characteristics minerals, mineral assemblages, metamorphic reactions and pressure-temperature conditions of metamorphism

2.3 Description of metamorphic facies of medium to high pressure with special reference to characteristics minerals, mineral assemblages, metamorphic reactions and pressure-temperature conditions of metamorphism.

2.4 Description of UHT and UHP metamorphism with special reference to characteristics minerals, mineral assemblages, metamorphic reactions.

UNIT-III

3.1 Heat flow and metamorphism: Paired Metamorphic belt, Schematic diagrams to illustrate the origin of paired metamorphic belts.

3.2 Ocean floor metamorphism and its types

3.3 Impact metamorphism

3.4 Anatexis and origin of migmatites

UNIT-IV

4.1 Metamorphic differentiation.

4.2 Characterization of metamorphic fluids and mineral-fluid equilibria, metasomatism

4.3 Metamorphic P-T-t paths and tectonic evolution. Geothermometry and Geobarometry

4.4 Plate tectonics and metamorphism

Books Recommended

1. Turner, F.J. (1980) Metamorphic Petrology, McGraw Hill, New York.
2. Yardlley, B.W.D. (1989) An introduction to Metamorphic Petrology, Longman Scientific and Technical, New York.
3. Philopotts, A.R. (1994) Principles of Igneous and Metamorphic Petrology, Prentice Hall.
4. Kretz, R. (1994) Metamorphic Crystallization, John Wiley.
5. Bucher, K. and Frey, M. (2002) Petrogenesis of Metamorphic Rocks (7th Rev. Ed.), Springer–Verlag.
6. Powell, R. (1978) Equilibrium thermodynamics in Petrology: An Introduction, Harper and Row Publ., London.
7. Wood, B.J. and Fraser, D.G. (1976) Elementary Thermodynamics for Geologists, Oxford University Press
8. Spry, A. (1976) Metamorphic Textures, Pergamon Press.
9. Winter, J.D. (2001) An introduction to Igneous and Metamorphic Petrology, Prentice Hall.
10. Sharma, Ram S. (2017) Metamorphic Petrology, Geological Society of India, Bangalore

Course No.: P2AGTC205 **Title: Geo-Exploration and Mining Geology**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in May 2026, May 2027 & May 2028)

Course Objectives: It is intended to familiarize the students with the principles, methodology and application of important geophysical and Geochemical methods adopted to investigate the surface and subsurface. To introduce the concept of exploratory mining methods.

Course Outcomes: After studying this course, students will be able to

- Understand the principles and methods of geological and geochemical exploration.
- Ascertain industrial and non industrial resources and distinction between reserve and resource.
- Apply geophysical techniques like gravity, electric, magnetic etc for subsurface investigations and their data interpretations.
- Develop a technical understanding of various mining techniques, their development and operations.

UNIT-I Geological and Geochemical exploration

1.1 Mineral exploration: Selection of area for prospecting. Stages of geological prospecting, Geological guides for the prospecting of mineral deposits; mineralogical, lithological and structural guides, gossans and capping.

1.2 Geochemical exploration Principle: mobility and geochemical association of elements. Primary and secondary geochemical dispersion patterns.

1.3 Methods and applications of geochemical exploration. Treatments of geochemical data.

1.4 Geobotanical survey: Uptake of mineral matters by plants, geobotanical indicators, geobotanical survey techniques. Biogeochemical anomalies and biogeochemical method of exploration.

UNIT-II Sampling methods, mineral resource classification and ore reserve estimation

2.1 Geological aspects of pitting, trenching and common drilling techniques.

2.2 Sampling and assaying: Theory, patterns and methods. Core logging and core sampling.

2.3 Resources and Reserves: Identified and Unidentified Resources, Measured, Indicated and Inferred Reserves, Para-marginal, Sub-marginal, Hypothetical and Speculative Resources; Classification Schemes, viz. USGS and UNFC Schemes.

2.4 Evaluation of exploration data and ore reserve estimation. Introduction to geostatistical estimation of reserves.

UNIT-III Exploration Geophysics I

3.1 Gravity method - basic principles. Earth's gravitational field and its relation to geophysical exploration. Instruments used in gravity prospecting - pendulum, torsion balance and gravimeters.

3.2 Reduction of gravity data, separation of regional and residual gravity anomalies and interpretation of gravity data.

3.3 Gravity corrections: Free-air correction, Bouguer correction, Latitude correction, Terrain correction

3.4 Magnetic method: Geomagnetic field, Induced magnetism, Remnant magnetism, Susceptibility, Field survey method, Equipment, Data processing, Qualitative and quantitative interpretation of magnetic data.

UNIT-IV Exploration Geophysics II

4.1 Electrical Methods: Electrical properties of rocks, Flow of current through ground surface, Apparent resistivity, Field procedures and electrode arrangements, VES and CST and their qualitative interpretation. Electromagnetic spectrum and induction,

4.2 Seismic Methods: Basic principles, Types of seismic waves and their propagation characteristic, Seismic velocities in Earth's materials.

4.3 Refraction technique - Time distance relations for horizontal interface, dipping beds and faults. Delay time, shot and detector arrangement and corrections.

4.4 Reflection technique - Time distance relations for horizontal and dipping interfaces, shooting procedures and corrections applied to reflection records.

UNIT-V Elements of mining

5.1 Introduction to mining, definitions and explanation of different mining terminology.

5.2 Introduction to Surface mining; deposits amenable to surface mining;Classification of surface mining systems.

5.3 Introduction to underground metal mining; deposits amenable to underground metal mining. Modes of entry to underground mineral deposits. Mine development: drifting, raising and winzing; Classification of underground metal mining methods. General description, applicability and operations involvedin different methods.

5.4 Introduction to underground coal mining:Broadclassificationof underground coal mining methods. Board and Pillar method, Logwall mining methods –general description and its advantages and disadvantages.

Books Recommended

1. Govett, G.J.S. (1983) Rock Geochemistry in mineral exploration, Vol.3.Elsevier Scientific Publishing Company.
2. Govett, W.K., Hoffman, S.J., Merthens, M.B., Sinclair, A.J. and Thomson, I. (1987). Exploration Geochemistry, Design and Interpretation of Soil Survey.Reviews in Economic Geology, Vol.4.
3. Hale, M. and Plant, J.A. (1994) Handbook of Exploration Geochemistry – Drainage Geochemistry, vol 6,Elsevier Scientific Publishing Company.
4. Levinson, A.A. (1974) Introduction to Exploration Geochemistry, Applied Publishing Ltd. USA.
5. Reedman, J. H. (1979) Techniques in mineral exploration.Applied Science Publishers.
6. Rose, Arthur W., Herbert, E. Hawkes and Webb, John S. (1979) Geochemistry in Mineral Exploration. Acad Press.
7. Evans (1998) Introduction to Mineral Exploration.*Blackwell Science*
8. McKinstry, H.E. (1967) Mining Geology, Prentice Hall,
9. Clark, G.B. (1967) Elements of Mining, III ed. John Wiley
10. Arogyaswami, R.P.N. (1996) Courses in Mining Geology, IV Ed. Oxford IBH
11. Garland GD (1979) Introduction to Geophysics. *W.B. Saunders Company*
12. Nettelton, L.L. (1976) Gravity and Magnetics in oil prospecting.*McGraw-Hill*
13. Dobrin, M.B. (1988) Introduction to Geophysical Prospecting. *McGraw-Hill*& C.H. Savit
14. Ramakrishna,T.S. (2006) Geophysical Practice in Mineral Exploration and Mapping.
15. Gandhi, S.M. & Sarkar, B.C. (2016) Essentials of mineral exploration and evaluation
16. Haldar, S.K. (2018) Mineral Exploration: Principles and Applications

Course No.: P2AGTC206 **Title: Earth Surface Features and Processes**
Credits: 02 **Maximum Marks: 50**
Duration of Examination: 2½ hours **(Minor I-10, Minor II 10, Major 30)**

(Syllabus for the examination to be held in May 2026, May 2027 & May 2028)

Course Objectives: To introduce the fundamental concepts governing the landforms; understand the concept of various geomorphological processes and landform evolution. Introduce the latest concept of chronology based on geomorphological studies in tectonic zones.

Course Outcomes: After studying this course, students will be able to

- Understand different land-forming processes that involve the shaping of earth surface structures over geological times
- Able to recognize different stages of landform cycles and their associated landforms through various geomorphological processes
- Understand how endogenic and exogenic forces played a major role in the evolutionary history of the Himalayas, Thar Deserts, and Western Ghats of Peninsular India

UNIT-I

1.1 Historical background of Geomorphology.
1.2 Lithological and structural control on landforms.
1.3 Qualitative and quantitative analysis of basins and drainage density.
1.4 Landform evolution by fluvial process

UNIT-II

2.1 Landform evolution by aeolian activity in hot arid regions
2.2 Landform evolution by marine processes
2.3 Glacier, types, and landform generation by glacial and fluvio-glacial processes
2.4 Morphometric parameters of mass movement deposits.

UNIT-III

3.1 Factors of weathering-mechanical disintegration, chemical decomposition.
3.2. Determination of weathering indices and ratios
3.3 Soils - soil formation and climate
3.4 Process of pedogenesis

UNIT-IV

4.1 Introduction to planetary geomorphology.
4.2 Morphotectonic evolution of Himalaya and Tibetan Plateau.
4.3. Evolutionary history of Thar Desert of India.
4.4. Morphotectonic evolution of Western Ghats of India.

Books Recommended

1. F.A. Pitty Introduction to Geomorphology
2. Donj-Easterbrook Principles of Geomorphology
3. C. Ollier Tectonics and Landforms
4. C. Ollier Weathering
5. Thornbury Geomorphology
6. A. Bloom Fluvial Geomorphology
7. C.A.M. King Introduction to Marine Geology and Geomorphology
8. K.S. Valdiya Aspects of Tectonics
9. Ronald Greeley Introduction to Planetary Geomorphology
10. R Greeley Planetary Landscapes

Course No.: P2AGPC207 **Title: Practicals related to 201, 202, 203, 204, 205**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 4 hours

P2AGPC201 Megascopic and microscopic study of clastic and non-clastic sedimentary rocks; Textural analysis of sedimentary rocks.

P2AGPC202 Application of zoological code of nomenclature for taxonomic studies. Study of mega and microfossils of various invertebrate, vertebrate and plant groups. Study of modes of fossil preservation. Univariate and bivariate analysis of fossils using regression analysis and major axis equations.

Cladogram construction.

P2AGPC203 Stereo test. Study of Aerial Photographs, resolution, mosaics, symbols, gully pattern and drainage analysis, image parallax. Determination of scale, height, dip, slopevertical exaggeration and image distortion; Visual interpretation of satellite imagery for geological structural geomorphic and hydro-morphological mapping; Exercises on digital image processing; Geometric correction and mosaicing of image; Vector functions - Spatial & attribute query; Data import and export; Geometric & Radiometric correction; Unsupervised classification; Supervised classification; Familiarization with ARC GIS software; Geo-referencing in ARC GIS; Digitization and layer creation; Data input, data editing and topology creation; Editing the &generation of Thematic layers Familiarization with GNSS receiver and to know the set up unit; Initialisation of the system in the field

P2AGPC204 Megascopic and microscopic studies of important metamorphic rocks with reference to texture/structure, time relation between phases of deformation and metamorphic crystallization, mineral association, parent rock, metamorphic facies to which rock can be assigned; Representation of assemblage in ACF, AKF and AFM.

P2AGPC205 Simple reserve estimation problems; Borehole correlation; Geochemical anomaly maps and its interpretation; Applying gravity corrections and preparation of gravity anomaly graphs for geophysical interpretation; Using seismic data from geophones to generate distance-time graphs and estimate subsurface stratigraphy.

SEMESTER - III

Course No.: P2AGTC301 **Title: Applied Micropalaeontology and Oceanography**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in December 2026, 2027, 2028)

Course Objectives:
1. To provide working knowledge of various microfossil groups and their geological significance
2. To study the modern concepts, dynamics and resources of the marine realm

Course Outcomes: Upon completion of this course the students will be able to

- Identify various microfossils
- Learn techniques for sampling, separating, and analyzing microfossils
- Apply microfossils in palaeoenvironmental, palaeoclimatic and palaeooceanographic studies, and hydrocarbon exploration
- Acquire a comprehensive understanding about oceans, their evolution, topography, sediments and dynamics
- Gain insights into the various resources of the marine realm and potential threats to it

UNIT-I

1.1 Microfossils - introduction, record, important groups. Microfossil sampling, techniques of separation; microfossils picking and mounting
1.2 Morphology, classification and geological significance of Ostracoda
1.3 Morphology, classification and geological significance of Foraminifera
1.4 Morphology, classification, distribution and geological significance of Radiolaria and Diatoms

UNIT-II

2.1 Morphology, classification, distribution and geological significance of Coccolithophores
2.2 Conodont: composition, elements, groups, apparatus and assemblages, biological affinities, history and geological significance. Pteropods and tentaculitids and their geological significance
2.3 Morphology, classification, distribution and geological significance of Acritarchs and Chitinozoans
2.4 Morphology, classification, distribution and geological significance of Dinoflagellates

UNIT-III

3.1 Morphology, classification, and geological significance of Charophytes Charophytes: morphology, classification, ecology and significance
3.2 Palynomorphs: Spores and pollens morphology (shape, aperture, composition and structure, sculpture, size) and their application. Phytoliths and their significance
3.3 Microfossils and biostratigraphy – biozones, biozonation, stratigraphic correlation and problems in biostratigraphic interpretations.
3.4 Application of microfossils in palaeoenvironment, palaeoclimate and palaeooceanographic studies and hydrocarbon exploration

UNIT-IV

4.1 Oceanography- origin and evolution of oceans; palaeoceanography – Palaeozoic, Mesozoic and Tertiary. Sea level fluctuations and their causes
4.2 Topographic features of the ocean floor. Hpsography of the continents and ocean floor. Classification of marine sediments, sediment budget, transport, accumulation. Coral reefs
4.3 Origin and evolution, structure and physiography, bathymetry and sediments of the Indian Ocean.
4.4 Wave dynamics: deep water, shallow water, wind waves; wave reflection, refraction and diffraction. Tides: equilibrium and dynamic theory, tidal currents in coastal areas, observation and prediction. Seiches and Tsunamis

UNIT-V

5.1 Heat budget and Atmospheric Circulation. Storms, jet streams, El Nino and land effects on winds. Ocean circulation: forces driving currents. Surface currents and their effects on climate
5.2 Thermohaline circulation and global heat connection. Wind induced vertical circulation. Seawater chemistry and dissolved gases. Density structure of ocean and stratification
5.3 Phytoplankton dynamics in the marine food web and factors limiting productivity. Marine physical and biological resources
5.4 Marine pollution – pollutants, habitat destruction and global changes (ozone layer depletion, global warming, acid rain)

Recommended Books

1. Danial J. Jones 1956 Introduction to Microfossils. Harper and Brothers, Harper Geoscience Series
2. M.D. Brasier 1980 Microfossils. George Allen & Unwin

3. Gerard Bignot 1985 Elements of Micro Palaeontology. Graham Trotman Limited
4. David G. Jenkins (Ed) 1993 Applied Micropalaeontology. Kluwer Academic Publishers
5. P.K. Kathal 1998 Microfossils and their applications. CBS Publishers
6. H.A. Armstrong and M.D. Brasier 2005 Microfossils. Blackwell Publishing
7. P.K. Kathal. 2012. Applied Geological Micropalaeontology. Scientific Publishers
8. P.K. Saraswati & M.S. Srinivasan 2016 Micropaleontology. Springer
9. S. Jain. Microfossils. 2020. Springer
10. Gross, M.G.1972 Oceanography - A view of the Earth. Prentice-Hall.
11. S. Davis, R.A. Jr. 1972 Principles of Oeanography. Addison -Wesley Publishing Company.
12. Bhatt, J.J. 1978 Oceanography - Exploring "the planet Ocean. D. van Nostrand Company.
13. Haq, B.U. & Milliman, J.D. 1984 Marine Geology and oceanography of Arabian Sea and coastal Pakistan. Elite Publishers Limited.
14. Roonwal, G.S. 1986 The Indian Ocean: Exploitable mineral & petroleum Resources. Narosa Publishing house
15. Duxbury, A.B. & Duxbury, A.C. 1993 Fundamentals of Oceanography. Wm. C. Brown Publishers.
16. Qasim, S.Z. & Roonwal, G.S. (eds) 1996 India's Exclusive Economic Zone. Omega Scientific Publishers.
17. Garrison, T. 1995 Oceanography- An invitation to Marine Science. Wadsworth Publishing Company.
18. A.P. Trujillo & H.V. Thurman 2012 Essentials of Oceanography. PHI Learning Private Limited
19. Garrison, T. & Ellis, R. 2016 Oceanography: An invitation to Marine Science, National Geographic Learning.
20. Savindra Singh. 2021. Oceanography. Indigo Books.

Course No.: P2AGTC302 **Title: Ore Geology**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hrs **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2026, Dec. 2027 & Dec. 2028)

Course Objectives: The course deals with the natural mineral resources and their association with different host rocks during their formation. The main objective of the course is to impart knowledge and understanding about the fundamental and advanced concepts regarding the origin of various ores and industrial minerals. To provide thorough knowledge on the mineral assemblages, textural features, paragenetic order and metallogeny and to understand the formation, mode of occurrences and types of various petrological ore associations.

Course Outcomes: Upon completion of the course, students will be able to:

- Understand the different ore systematic at divergence geological setting and terrains with implications for exploration.
- Identification of minerals based on their optical properties and textural behaviour and their application in mineral beneficiation industries.
- To know the source and depositional environment based on isotopic and fluid inclusion studies.
- To apply the knowledge in exploration of the mineral resources
- To understand the use of minerals in Industry

UNIT-I: Ore Geology Techniques

1,1 Introduction to ore mineralogy and ore microscopy
1.2 Qualitative and Quantitative methods in the identification of Ore minerals.
1.3 Introduction to ore textures, microstrutures and applications: Ore textures and paragenesis. Industrial application of ore microscopy
1.4 Fluid Inclusion studies.

UNIT-II: Othomagmatic Ore Deposits associated Mafic and Ultramafic rocks

2.1 Chromite deposit associated with mafic and ultramafic rocks: their types and genetic models.
2.2 Genesis of Cu-Ni ± Co sulphides deposits associated with magmatic processes.
2.3 Diamond deposits associated with Kimberlites their characteristics and genetic models.
2.4 REE-Nb-Industrial minerals (± Cu) mineralization associated with Carbonatites- their characteristics and genesis.

UNIT-III: Late Magmatic Deposits associated with Felsic rocks

3.1 Granite-related mineralization systems: diversity of mineralization styles and relatedmineral deposits.
3.2 Porphyry copper deposits- types, characteristics, associated alterations and origin.

3.3 Intrusion-related gold systems
3.4 Pegmatites and associated mineralization.

UNIT IV: Hydrothermal System
4.1 Components of hydrothermal system, Geodynamics and Temporal Evolution of Hydrothermal Mineral Systems
4.2 Hydrothermal Processes and Wall Rock Alteration.
4.3 Intrusion related Hydrothermal system, mineralisation associated with greisens and skarns
4.4 Submarine hydrothermal system: Volcanic hosted massive sulfide deposits – types, characteristics and mode of occurrences

Unit V Ore Deposits associated with Sedimentary and weathering processes
5.1 Placers and paleoplacers – process and mechanism of development, tectonic and temporal aspects of placer deposition and origin of ores
5.2 Sedimentary and synsedimentary iron ore deposits – types, general characteristics and origin..
5.3 Stratabound carbonate hosted base metal deposits – types, general characteristics and genetic models.
5.4 Ores related to weathering processes – bauxite, laterite and Ni/Au-laterite deposits, general characteristics and process of formation. Supergene enrichment.

Books Recommended

1. Craig, J.R and Vaughan, D.J., 1981. Ore Microscopy and Ore petrography. John Wiley&sons
2. Kula C Misra. 2001. Understanding Mineral Deposits. Kluwer Publ.
3. Robb, L. (2005) Introduction to Ore-Forming Processes by, Blackwell Publishing Ltd.
4. H.L.Barnes (Ed). 1997. Geochemistry of Hydrothermal deposits. III Edn. John Wiley & Sons.
5. A.M. Evans. 1997: Ore Geology and Industrial minerals- An introduction (III edn.) Geoscience, Texas
6. Mukerjee A Ore Genesis: A Hollastic Approach
7. Robb, L J Introduction to Ore Forming Processes
8. Pirajno Franko Hydrothermal Mineral Deposits
9. Sharma,R&Srivastava,PK Hydothermal Fluids of Magmatic origin in S Kumar and R N Singh Modelling of Magmatic and allied processes, Springer
10. Srivastava, P K On e-pathshala on website of UGC, New Delhi

Course No.: P2AGTC303 **Title: Sedimentary Basin Analysis & Hydrocarbon Resources**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2026, Dec. 2027 & Dec. 2028)

Course Objectives: This course is about deciphering the earth's history from the pages of the earth's past written in the sedimentary rocks. The course shall help students to understand the evolution and depositional mechanism of different sedimentary basins in relation to endogenic and exogenic controls.

Course Outcome: Sedimentary Basin Analysis course shall reflect the advanced understanding and analytical capabilities expected at the postgraduate level with critical thinking, technical proficiency and research skills. The students shall be able to analyze the tectonic settings and geodynamic evolution of some important sedimentary basins in India. This course shall help the students to interpret sedimentary facies, depositional environments, and sequence stratigraphy for basin classification and resource evaluation. In addition, the students shall learn to integrate geological, geophysical, and geochemical data for resource assessment in sedimentary basins.

UNIT-I Basins and their evolution
1.1 Mechanisms of basin formation; Continental and marine sedimentary basins, Allogenic controls on basin evolution
1.2 Tectonic classification of sedimentary basins – intra-plate basins (pre-rift); divergent-margin basins (syn-rift); intra-plate basins (post-rift); convergent-margin basins; collision and post-collision basins; strike-slip basins.
1.3 Tectonic evolution of Siwalik basin as an example of collision tectonics
1.4 Tectonic evolution of Kutchchh basin as an example of extensional tectonics

UNIT-II Basin Analysis
2.1 Methods of basin analysis (Tectonic, stratigraphic and sedimentological)
2.2 Tools of basin analysis– Facies analysis, sediment dispersal and palaeo-flow analysis

2.3 Geophysical tools (seismic, gravity), Geochemical tools (organic and mineral geochemistry)
2.4 Application of carbon and oxygen isotopes in sedimentology

UNIT-III Depositional Environments

3.1 Classification of sedimentary environments
3.2 Continental sedimentary environments (Fluvial, Lacustrine)
3.3 Shallow marine sedimentary environments (Estuary, Delta, Tidal flat, Lagoon)
3.4 Deep marine sedimentary environment (Submarine fan, Abyssal plain)

UNIT-IV Sequence Stratigraphy

4.1 Concept of sequence stratigraphy, Sea level changes, aggradation, progradation, retrogradation, transgression and regression; Eustatic sea level changes
4.2 System tracts - lowstand system tract, transgressive system tract, transgressive surface and highstand system tract
4.3 Sequences, parasequences; Flooding surface, maximum flooding surface, marine flooding surface; overlap, offlap, toplap and onlap
4.4 Sequence stratigraphic approach in basin analysis and case history of important petroliferous basins of India.

UNIT-V Hydrocarbon Basins

5.1 Origin of Petroleum (Inorganic and Organic theories). Generation, maturation process, migration and accumulation of oil and gas, oil shales
5.2 Concept of petroleum system: Reservoir rocks (clastic and non-clastic reservoir rocks, development and types of porosity in these rocks. Controls of permeability).
5.3 Petroleum traps: Cap rocks (seals), Occurrence, surface indications and direct detection of hydrocarbons.
5.4 Petroliferous basins of India (Assam, Bombay High, Ankleshwar)

Books Recommended

1. Miall, Andrew D. — Principles of Sedimentary Basin Analysis
2. Miall, A D. — Fluvial Depositional System
3. Lindholm, R. C. — A Practical Approach to Sedimentology
4. Reineck, H. E. & Singh, I. B. — Depositional Sedimentary Environments
5. Reading, H.G. — Sedimentary Environments
6. Selley, R.C. — Applied Sedimentology
7. Bjorlykke, K. — Sedimentology and Petroleum Geology
8. Leeder, M.R. Sedimentology: — Process and Product
9. Prothero and Schwab — Sedimentary Geology
10. Swift, Oertal, Tillman and Thorne — Shelf Sand and Sandstone Bodies:
11. Zutshi and Panwar — Geology of Petroliferous Basins of India
12. Bhandari et al. — Petroliferous Basins of India
13. Miall, A D — The Geology of Sequence Stratigraphy
14. Catuneanu O — Principles of Sequence Stratigraphy
15. Gary Nichols — Sedimentology and Stratigraphy
16. Stephen Killops and Vanessa Killops — Introduction to Organic Geochemistry
17. Sam Boggs, Jr. — Principles of Sedimentology and Stratigraphy
18. Barker, C. — Thermal Modeling of Petroleum Generation
19. Holson, G.D. and Tiratso, E.N. — Introduction of Petroleum Geology
20. Hunt, J.M. — Petroleum geochemistry and geology
21. Jahn, F., Cook, M. and Graham, M. — Hydrocarbon Exploration and Production
22. North, F.K. — Petroleum Geology,
23. Selley, R.C. — Elements of petroleum geology,
24. Tissot, B.P. and Welte, D.H. — Petroleum formation and occurrence

Course Code: P2AGTC304 **Course Title: Geotechnical Engineering**
Course Credit: 4 **Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in Dec. 2026, Dec. 2027 & Dec. 2028)

Course Objectives: This advance course in geotechnical engineering aims to provide students with a comprehensive understanding of soil and rock mechanics fundamentals, including their formation, classification, and engineering properties. The objective is to equip students with the knowledge and skills necessary to analyze the stress-strain behavior and shear strength of soils, understand rock mass characterization and classification systems. Furthermore, the course seeks to introduce the principles of rock mechanics, covering intact rock properties, the influence of discontinuities in rock masses, and various rock mass classification systems like RQD, RMR, Q-system,

and SMR. A significant objective is also to equip students with knowledge for analyzing and addressing geotechnical challenges in engineering projects.

Course Outcomes: Upon completion of this course

- Students will be able to classify and characterize various soil types based on their physical and index properties
- They will be able to analyze the stress-strain behavior of soils
- Students will be capable in understanding and applying various shear strength theories and laboratory/field tests for soils.
- Understand the significance of discontinuities, and apply different rock mass classification systems to assess rock quality for engineering applications in various geotechnical engineering projects such as dams, highways, tunnels, and bridges.

Unit 1: Fundamentals of Soil Mechanics

1.1- Introduction and scope of geotechnical engineering; Types of geotechnical investigations associated with dams, highways, tunnels and bridges.

1.2- Concept of soil mechanics; Phase relationships of soils: water content, specific gravity, absorption value, degree of saturation, void ratio, porosity, unit weights.

1.3- Index Properties of Soil - Atterberg's limits (Liquid Limit, Plastic Limit, and Shrinkage Limit) and their significance; Particle size distribution (sieve analysis, hydrometer analysis); Soil compaction: principles and methods (Proctor test).

1.4- Concept of Permeability & Seepage; coefficient of permeability; factors affecting permeability; laboratory and field permeability tests, significance of the permeability & seepage test.

Unit 2: Stress-Strain Behavior of Soils and Shear Strength

2.1- Concepts of stress, strain, and elastic moduli; total stress, pore water pressure, and effective stress; importance of effective stress in geotechnical analysis.

2.2- Concept of Mohr-Coulomb failure criterion; parameters of shear strength: cohesion (c) and angle of internal friction (phi), factors affecting shear strength (draining conditions, stress history).

2.3- Laboratory Shear Strength Tests: Direct Shear Test, Triaxial Compression Test, Vane Shear Test; their advantages, and limitations.

2.4- Field Shear Strength Tests: Standard Penetration Test (SPT), Cone Penetration Test (CPT), their correlation with soil properties and its applications.

Unit 3: Rock Mechanics Fundamentals & Rock Mass Characterization

3.1- Introduction to Rock Mechanics: Rock as an engineering material; Selection criteria of rock masses for various purposes; Differences between intact rock and rock mass properties.

3.2- Intact Rock Properties: Physical properties: density, porosity, water absorption, Mechanical properties: Uniaxial Compressive Strength (UCS), Tensile Strength, Modulus of Elasticity, Poisson's Ratio.

3.3- Discontinuities in Rock Masses: Joints: Formation, types, and geological significance; Geometric parameters of discontinuities/joints: orientation (strike, dip, dip direction), spacing, persistence, roughness, infilling, weathering condition.

3.4- Concept and scope of kinematic analysis of rock slopes for knowing various modes of failures; Conditions of planar failure, wedge failure and toppling failures.

Unit 4: Rock Mass Classification Systems & Applications

4.1- Introduction to Rock Mass Classification: Rock Quality Designation (RQD): Limitations and applications of RQD in rock mass quality assessment.

4.2- Concept of Rock Mass Rating (RMR) System: Parameters of RMR (UCS, RQD, spacing of joints, condition of joints, groundwater, and orientation of joints); Calculation of RMR_{basic}; Applications of RMR in tunneling and slope stability.

4.3- Introduction to tunneling index (Q-System); parameters of Q-system: rock quality assessment, joint roughness number (Jr), joint set number (Jn), joint alteration number (Ja), joint water reduction (Jw), stress reduction factor (SRF); Calculation and interpretation of Q-value; Applications of Q-system, tunnel supports.

4.4- Introduction to Slope Mass Rating (SMR) System; Extension of RMR for slope stability analysis; Parameters of SMR and its modifications; Application of SMR in evaluating rock slope stability.

Unit 5: Landslides and Slope Stability

5.1- Landslides: nomenclature; significance and global impact of landslides, classifications (Varnes, 1978; Van Schalkwyk and Thomas, 1991; Cruden and Varnes, 1996)

5.2- Factors triggering landslides: role of geological, hydrological and anthropogenic factors; failure mechanism; Concept of the factor of safety in slope stability

5.3- Concept of landslide susceptibility mapping: Heuristic (Qualitative) Methods, Statistical Methods; Machine Learning techniques, Deterministic (Physical-Based) Models and Hybrid Methods.

5.4- Landslide mitigation measures: slope modification, drainage improvement, retaining structures, rock fall protection, slope reinforcement practices; Role of public awareness and education in reducing landslides; early warning systems

Recommended Books:

1. Principles of Geotechnical Engineering by Braja M. Das (2017)
2. Soil Mechanics in Engineering Practice by Terzaghi, Peck &Mesri (1996)
3. Soil Mechanics and Foundations by B.C. Punmia (2017)
4. Soil Mechanics by T. William Lambe & Robert V. Whitman (1969)
5. Fundamentals of Soil Behavior by James K. Mitchell (2005)
6. Soil Testing for Engineers by T.W. Lambe (1951)
7. Field Testing and Instrumentation of Soils by P. Mohan Das (2009)
8. Introduction to Rock Mechanics by Richard E. Goodman (1989)
9. Rock Mechanics for Underground Mining by B.H.G. Brady & E.T. Brown (2004)
10. Engineering Geology by F.G. Bell (2007)
11. Practical Rock Engineering by Evert Hoek (2007)
12. Engineering Rock Mass Classifications by Z.T. Bieniawski (1989)
13. Rock Slope Engineering by Wyllie & Mah (2004)
14. Geotechnical Engineering Investigation Manual by Roy E. Hunt (2005)
15. Landslide Hazard and Risk edited by Glade, Anderson, and Crozier (2005)
16. Stabilization of Earth Slopes and Landslides by Donald H. Gray (2012)
17. Principles of Engineering Geology by Prabin Singh
18. A textbook of General and Engineering Geology by D. S. Arora.

Course No.: P2AGTC305 **Title: Application of Remote Sensing & GIS in Geology**
Credits: 02 **Maximum Marks: 50**
Duration of Examination: 2½ hours **(Minor I-10, Minor-II 10, Major -30)**

(Syllabus for the examination to be held in Dec 2026, Dec 2027 & Dec 2028)

Course Objectives: Role of Remote Sensing & GIS technology in geology, geomorphology, lithology interpretation and resultant landforms. Geospatial applications in watershed management, Mineral & oil Exploration and disaster management

Course Outcomes: On successful completion of the course the students will be able-

- To understand the concepts of remote sensing applications in the geology
- To examine the spectral characteristics of rocks and minerals.
- To understand drainage patterns, Lithology and structural interpretation of folds, faults, fluvial, glacial & karst landforms.
- To analysis the DEM for Terrain Evaluation, structural and denudational landforms.
- Remote sensing & GIS application in Watershed management, mineral exploration, oil exploration, geological hazards mapping and disaster management.

Unit-1

1.1 Remote Sensing in geology – an overview
1.2 Basic concept of geomorphology, earth surface process and resultant landforms
1.3 Spectral characteristics of rocks and minerals
1.4 Interpretation of drainage patterns – types and its significance in geologic interpretation

Unit -2

2.1 Lithological interpretation: Igneous rocks, Sedimentary rocks and MetamorphicnRocks; lithological mapping
2.2 Structural interpretation: folds, faults unconformities and lineaments; structural mapping
2.3 Interpretation of fluvial landforms
2.4 Interpretation of glacial and Karst landforms

Unit – 3

3.1 Digital Elevation Model, terrain evaluation and geomorphological mapping
3.2 Interpretation of structural and denudational landforms – cuesta, hogback, butte, mesa, etc
3.3 Interpretation of landforms related to igneous, sedimentary and metamorphic rocks
3.4 Morphometric analysis and its applications in morphotectonics

Unit – 4

4.1 Remote Sensing in water exploration; Role of Remote Sensing in watershed conservation, planning and management

4.2 Remote sensing in mineral exploration - an overview and application of remote sensing in mineral exploration - Indian examples
4.3 Remote sensing in oil exploration - features helpful in detection of target areas for oil exploration
4.4 Geological hazards mapping and disaster management

Books Recommended

Drury, S.A., 1987	Image Interpretation in Geology. Allen and Unwin
Gupta, R.P.., 1990	Remote Sensing Geology. Springer Verlag.
Jensen, J.R. 2000	Remote Sensing of the Environment: An Earth resource Perspective. Prentice Hall
Lillesand, T.M., and Kieffer, R.M., 1987	Remote Sensing and Image Interpretation, John Wiley.
Paine, D.P., 1981:	Aerial Photography and Image Interpretation for Resource Management. John Wiley.
Pandey, S.N., 1987:	Principles and Applications of Photogeology. Wiley Eastern.
Miller, V.C., 1961:	Photogeology. McGraw Hill.
Ray, R.G., 1969:	Aerial Photographs in geologic Interpretations. USGS Prof, Paper 373.

Course No.: P2AGTC306 **Title: Practicals related to 301, 302, 303, 304, 305**
Credits: 04
Maximum Marks: 100 **Duration of Examination: 4 hours**

P2AGPC301 Palaeocurrent analysis: Tilt correction, calculation of azimuthal direction; Preparation and interpretation of lithologs and isopach maps; Analysis of seismic profiles; Delineation of sequence boundaries, systems tracts and parasequences in sedimentary sequences

P2AGPC302 Processing of samples, picking and mounting of microfauna, study of diagnostic morphological characters of selected microfossils, construction of biostratigraphic charts, ocean floor profiles, bathymetry of oceanic sub-environments, circulation patterns etc.

P2AGPC303 Petrography of clastic and non-clastic rocks; Palaeo-current analysis: Tilt correction, calculation of azimuthal direction; Preparation and interpretation of lithologs and isopach maps; Analysis of seismic profiles; Delineation of sequence boundaries, systems tracts and parasequences in sedimentary sequences

P2AGPC304 Kinematic analysis of joint data, determination and interpretation of various rock mass classification systems, including RQD (Rock Quality Designation), RMR_b (Rock Mass Rating Basic), Slope Mass Rating (SMR) and Tunneling Index (Q-system); determination of Atterberg limits and Uniaxial Compressive Strength (UCS) test of rocks.

P2AGPC305 Visual interpretation of satellite images to study the Geomorphology, lithology, geology and structure; Digital image processing for the study of geomorphology, structure, and lineaments; Geomorphic mapping; Lineament mapping; Structural mapping; Preparation of Hydro-geomorphology map.

Course No P2AGRC307 **Geological Field Work (Outstation 10-15 days)**
Credits: 2 **Max. Marks: 50**

This course shall comprise of 10-15 day's field work in areas of geological interest, preferably out of state. The students shall have experiential learning on map reading, rock and mineral identification, geological mapping in structurally complexed terrain/ mineralised area / Industrial training/ visit to mining areas etc. Practical skills such as field mapping, understanding the relationships between different rock types and their formation processes, sample collection, data recording, data interpretations and report writing are also emphasized. At the end the students shall submit a comprehensive field report. The distribution of marks shall be as follows:

Attendance: 10%
Performance during the fieldwork: 20%
Field Report: 60%
Viva-voce at the time of external examination: 10%

SEMESTER - IV

Course No.: P2AGTC401 **Title: Quaternary Geology and Palaeoclimate**
Credits: 04 **Maximum Marks: 100**
Duration of Examination: 3 hours **(Minor I-20, Minor II 20, Major 60)**

(Syllabus for the examination to be held in May 2027, May 2028 & May 2029)

Course Objectives: This course is designed for postgraduate students in Geology, aiming to provide both theoretical and practical understanding of Earth's recent geological past and its climate history. The students shall study the fundamental aspects of Geology that help in understanding and reconstruction of palaeoclimate and active tectonics during the Quaternary time period.

Course Outcomes: This course shall help the students to

- Understand the processes that have resulted into the climate change and tectonic deformation during the Quaternary time period.
- Understand the role of different environmental and geological proxies to reconstruct past climate changes
- Equip the students with skills in analytical methods used in Quaternary geology research

Unit I: Fundamentals of Quaternary Period and Climate Change

1.1. Pleistocene and Holocene: Definition, chronology, subdivisions and duration.
1.2. Earth's climate system: The causes and timescale of climatic variations, solar forcing and earth's orbital parameters.
1.3. Tectonic scale climate change: Plate tectonics and long-term climate change, CO2 and long-term climate change,
1.4. Major Global Quaternary Events: Ice ages, Younger Dryas, Holocene Climate Optimum

Unit II: Palaeoclimate Proxies and Reconstruction

2.1. Palaeoclimate proxies: Ice cores, tree rings, speleothems, marine and lake sediments.
2.2. Stable isotopes ($\delta^{18}O$, $\delta^{13}C$), biomarkers, and geochemical indicators of palaeoclimate.
2.3. Palaeotemperature and palaeo-precipitation reconstruction.
2.4. Palaeoenvironmental archives in India (Himalaya, Peninsular lakes, Ganga plains)

Unit-III: Tectonic Geomorphology

3.1. Tectonic Geomorphology: Geomorphic markers, Planer and Linear markers.
3.2. Geomorphic Indices of Active Tectonics: Hypsometric Curve and Hypsometric Integral Drainage Basin Asymmetry, Stream Length-Gradient Index (SL) and Mountain-Front Sinuosity.
3.3. Drainage Pattern and Structural control over the rivers in different tectonic environment.
3.4. Tectonic Geomorphology and faulting: Landforms in compressional, extensional, and strike-slip regime.

Unit-IV: Active Tectonics and Geodesy

4.1. Active Faults, geomorphic and geological signatures of active faults.
4.2. Displacement variations along an active fault, fault growth, and fault segmentation.
4.2. Surface rupturing and buried faults in different tectonic settings.
4.3. Geodesy: Fundamentals of geodesy, crustal deformation across fault zones, interseismic strain accumulation.

Unit-V: Palaeoseismology

5.1. Introduction to Palaeoseismology, relationship with other neotectonic studies.
5.2. Classification of Paleoseismic Evidence: Primary and secondary evidence of prehistoric earthquakes.
5.3. Field techniques in paleoseismology: Mapping paleoseismic landforms, locating sub-surface deformation, GPR survey, trenching and logging.
5.4. Prehistoric earthquake dating and recurrence, dating techniques, precision and their relation to recurrence.

Recommended Books

1. Bowen, D.Q. (1999). A Colour Atlas of Glacial Indicators. CRC Press.
2. Lowe, J.J. & Walker, M.J.C. (2014). Reconstructing Quaternary Environments. Routledge.
3. Ruddiman, W.F. (2008). Earth's Climate: Past and Future. W\.H. Freeman.
4. Roberts, N. (2013). The Holocene: An Environmental History. Wiley-Blackwell.
5. Bradley, R.S. (2014). Paleoclimatology: Reconstructing Climates of the Quaternary. Academic Press.
6. Burbank, Douglas West_ Anderson, Robert Stewart - Tectonic Geomorphology (2012, Wiley-Blackwell_J. Wiley & Sons) - libgen.lc
7. Goudie, A. (2004). The Human Impact on the Natural Environment. Wiley-Blackwell.
8. Edward A. Keller - Active Tectonics Earthquakes, Uplift, and Landscape-Prentice Hall College Div (1995).

Course No.: P2AGTC402 **Title: Natural Hazards and Disaster Management**
Credits: 02 **Maximum Marks: 50**
Duration of Examination: 2½ hours **(Minor I-10, Minor-II 10, Major -30)**

(Syllabus for the examination to be held in May 2027, May 2028 & May 2029)

Course Objectives: This course aims to provide students with the essential knowledge and skills needed for hazards and disaster management. The primary objective is to enable students to understand the types, causes, and consequences of various hazards, both natural and human-induced. Students will learn to assess vulnerability and risk, comprehend different disaster management strategies, and analyze the crucial roles of institutions and stakeholders in this field. The course seeks to foster critical thinking, preparing students for effective disaster preparedness, response, recovery, and long-term resilience building.

Course Outcomes: Upon completing this course, students will be able to

- Effectively analyze vulnerability and its implications on disaster risk.
- Capable of applying the disaster management cycle to real-world scenarios and will possess a clear understanding of the institutional frameworks and emerging trends in disaster management
- Able to recognize the vital roles of various stakeholders in disaster risk governance, contributing to the country's capacity-building efforts toward a more disaster-resilient society

Unit 1: Fundamentals of Hazards and Risk

1.1- Introduction to Hazards: Definition and classification of hazards, distinguish between natural and anthropogenic hazards, causes and consequences.
1.2- Introduction to Disaster Risk: Core concept of disaster risk, key components of disaster risk, interrelationship between hazards, vulnerability, and capacity
1.3- Understanding Vulnerability: Various forms of vulnerability- physical, social, economic, and environmental vulnerability; role and contribution of vulnerability to amplify disaster risk.
1.4- Overview of major geohazards: Comprehensive look at the mechanisms, impacts, initial mitigation strategies.

Unit 2: Key Hazards and Disaster Management Cycle

2.1- Cyclones, Wildfires and Droughts: characteristics, causes, preventive measures and socio-economic consequences of specific hazards.
2.2- Core Concepts of Disaster Management (DM): Definition and scope of disaster management, its key components, distinction between Crisis Management and Risk Management.
2.3- Disaster Management Cycle: Pre-disaster stages (prevention, mitigation, preparedness); Syn-disaster stage-emergency stage (response); post-disaster stages (rehabilitation, reconstruction, recovery).
2.4- Impact of Disaster on Development: Analysis of how disasters impact development; paradigm shift in disaster management.

Unit 3: Policy Frameworks for Disaster Risk Reduction

3.1- Approaches to Disaster Risk Reduction (DRR): Comprehensive study of prevention, mitigation, and preparedness strategies as fundamental components of disaster risk reduction.
3.2- India's National DM Policy: Overview of India's national policy on disaster management;
3.3- Evolution and key features of India's DM policy; legal framework; Disaster Management Act, 2005.
3.4- National Disaster Management Framework (India): Structure and functions of key national, state, and district-level authorities in India (NDMA, NEC, SDMA, DDMA).

Unit 4: Stakeholders and Future of Disaster Management

4.1- Disaster Profile of India: Analysis of major disasters in India, including their regional and seasonal profiles, and lessons learned from past events.
4.2- Stakeholder Roles and Responsibilities: Roles of specialized institutions like NIDM and NDRF and SDRF, armed/paramilitary forces.
4.3- Roles of urban and local bodies, social networking, print and electronic media, NGOs, and local communities.
4.4- Global Challenges and Opportunities: Overview of global challenges in disaster management and emerging opportunities for innovation and collaboration.

Recommended Books:

1. Confronting Catastrophe: New Perspectives on Natural Disasters- Alexander, D. (2000).
2. Natural Hazards and Disasters- Donald Hyndman & David Hyndman (5th Edition, 2016)
3. At Risk: Natural Hazards, People's Vulnerability and Disasters- Piers Blaikie, Terry Cannon, Ian Davis, Ben Wisner (2nd Edition, 2004)
4. Introduction to Geomorphology and Natural Hazards- K.S. Valdiya (Universities Press, 2010)
5. Disaster Management: Future Challenges and Opportunities- R.B. Singh (Springer, 2014)
6. Disaster Management- S.C. Sharma (Khanna Publishing, 2019)

7. Introduction to International Disaster Management- Damon P. Coppola (Butterworth-Heinemann, 3rd Edition, 2015)
8. Disasters and Development- Cuny, Frederick C. (Oxford University Press, 1983)
9. Handbook of Disaster Risk Reduction and Management (Ben Wisner, JC Gaillard, Ilan Kelman (Routledge, 2021)
10. Disaster Management in India (Ministry of Home Affairs, Government of India, 2011)
11. The Sendai Framework for Disaster Risk Reduction 2015–2030: A Critical Appraisal- Rajib Shaw (Springer, 2016)
12. Role of Institutions in Disaster Risk Reduction and Management (NIDM, Government of India)
13. India Disaster Report: Towards a Policy Initiative- Parasuraman & Unnikrishnan (Oxford University Press, 2000)
14. Community-Based Disaster Risk Reduction- Rajib Shaw (Emerald Publishing, 2012)
15. Disaster Risk Governance in India and Cross Cutting Issues- Indrajit Pal, Rajib Shaw (Springer, 2017)
16. Disaster Risk Reduction for the Built Environment- Lee Bosher (Wiley-Blackwell, 2014)

Course No.: P2AGTE403 **Title: Gemology**
Credits: 02 **Maximum Marks: 50**
Duration of Examination: 2½ hours **(Minor I-10, Minor II 10, Major 30)**

(Syllabus for the examination to be held in May 2027, May 2028 & May 2029)

Course Objectives: To introduce the students about the concepts and techniques for identification of gemstones

UNIT - I Basics of Gemology

1.1 Gem and gemstones; General characteristics and chemical composition of gemstones; Nature of gem material: quality necessary in gems-beauty, rarity, durability.
1.2 Formation of gem stones. Crystal form and habit.
1.3 Nature of crystals: distinction between crystalline and amorphous material, crystal symmetry, Twinning, parallel growth, crystal form, crystal habit, seven crystal system. Identification of rough stones.
1.4 Classification of gem stones

UNIT - II Physical Characteristics of Gemstones

2.1 Physical characteristics of gemstones; Cleavage, Fracture, parting, and their importance in gemology and lapidary work. Units of measurement: metric scale, carat, pearl and grain.
2.2 Colours in gemstone: causes
2.3 Hardness its applications in gemology and limitations.
2.4 Quantitative determination of Specific gravity of gemstones by hydrostatic weighing, heavy liquids, flotation and pycnometer. Inclusions and other features of gemstones

UNIT - III Optical Characteristics of Gemstones

3.1 Electromagnetic spectrum, reflection and its importance in gemology, lustre, aventurescence, sheen, chatoyancy, asterism, luminescence, play of colours, labradorescenceetc.
3.2 Principal, Construction and use of refractometer in gemology
3.3 Polariscope and Dichroscope: construction and use in gemology,
3.4 Application of Chelsea colour filter, Infra-red ultraviolet and x-rays in gem identification

UNIT - IV Advance Gemology

4.1 Synthetic gemstones, methods of synthesis, and its characteristics. differentiation between natural and synthetic stones
4.2 Gem enhancement methods and their identification: colourless/coloured impregnation, heat treatment, coating, irradiation, diffusion, treatment, etc.
4.3 Imitation gemstones, glass and plastic imitations; organic materials. Pearls, corals, ivory and shells and amber and others
4.4 Grading of diamonds and coloured gemstones

Recommended Books:

1. Brocardo, G. (1981) Minerals and Gemstones – An identification Guide
2. Bruton Eric F.G.A. (1970) Diamonds
3. Karanth, R. V (, 2000). Gems and Gem Industry, Geological Society of India, Memoir, 45
4. Max Bauer (1968) Precious stones, Vol. I and II
5. Orlov Yu L (1973) The Mineralogy of the Diamond
6. Rajendran S. (2007): Mineral Exploration: Recent Strategies
7. Wilson, M. (1967) Gems

Course Code: P2AGTE404 **Course Title: Glaciology**
Course Credit: 2 **Marks: 50**
Duration of Examination: 2½ hours **(Minor I-10, Minor II 10, Major 30)**

(Syllabus for the examination to be held in May 2027, May 2028 & May 2029)

Course Objectives: This course aims to give students an extensive understanding of the processes involving ice, snow, and glaciers in the Earth's cryosphere. It seeks to educate students on the dynamics, development, and interactions of glaciers with climate systems. The importance of glaciers in hydrology is emphasized in the course, particularly as it relates to the Himalayan region and the management of water resources. Students will gain knowledge on how to use technology and field-based methods to examine glacial processes and features. The effects of climate change on glaciers and related hazards like GLOFs are also emphasized.

Course Outcome: Upon successful completion of the course students will be

- Understanding of the dynamics, formation, and melting processes of glacier
- Able to evaluate the environmental effects of glacier-climate interaction
- Comprehend how glaciers, specifically in the Himalayan environment, play a hydrological function in managing water resources
- Prepared to assess the environmental and social effects of glacier retreat and related risks like floods caused by glacial lake outbursts

Unit 1: Introduction to Glaciology and Fundamental Concepts

1.1 Definition and Scope of Glaciology: Importance in Earth sciences and applications in climate and environmental studies

1.2 Types and Distribution of Glaciers: Alpine, continental, and other glacier types; Global glacier distribution and major ice sheets

1.3 Glacier Formation and Mass Balance: Snow accumulation and transformation into glacial ice; Mass balance concepts and equations

1.4 Glacier Geometry and Classification: Glacier morphology (cirques, valley glaciers, ice caps); Classification based on thermal regime (temperate, polar)

Unit 2: Glacier Dynamics and Movement

2.1 - Mechanisms of Glacier Motion: Internal deformation, basal sliding, and subglacial bed deformation

2.2 - Glacier Flow Laws and Models: Glen's flow law, creep, and stress-strain relationships

2.3 - Ice Rheology and Deformation: Crystal structure of ice; Temperature and impurity effects on flow

2.4 - Velocity Measurement and Flow Patterns: GPS, remote sensing, and field methods; Longitudinal and transverse velocity profiles

Unit 3: Glacier Hydrology and Thermal Regime

3.1 Glacial Meltwater and Drainage Systems: Supraglacial, englacial, and subglacial drainage networks

3.2 Heat Transfer in Glaciers, Temperature Profiles and Thermal Zonation: Conduction, convection, and latent heat; Cold vs warm-based glaciers; Seasonal variations in glacier temperature

3.3 Glacial Surges and Thermal Feedbacks: Mechanisms and case studies of glacial surging; Role of thermal conditions in glacier instability

3.4 Glacial Lakes and GLOFs (Glacial Lake Outburst Floods): Formation and types of glacial lakes; Triggering mechanism

Unit 4: Glacial Landforms and Climate Change

4.1 Erosional and Depositional Landforms of glaciers; Glacial Sediments and Transport Mechanisms: Till, glaciofluvial and glaciolacustrine deposits; Modes of sediment transport: supraglacial, englacial, subglacial

4.2 Periglacial Processes and Features: Permafrost, patterned ground, solifluction, etc.

4.3 Glaciers as Indicators of Climate Change: Ice core records, past climates, glacier response lags

4.4 Glacier Retreat and Hazards: Mass balance loss, rapid melting, rising GLOF risk; Concept of Monitoring and Modeling Glacier Changes.

Books recommended

1. Glaciers and Glaciation – Douglas I. Benn & David J.A. Evans (2nd Ed.)
2. The Physics of Glaciers – Kurt M. Cuffey & W.S.B. Paterson (4th Ed.)
3. Fundamentals of Glacier Dynamics – C.J. van der Veen
4. Introduction to Modern Glaciology – C.J. Fierz & A. Lüthi (Selected Chapters)
5. Ice Physics – Peter V. Hobbs
6. Remote Sensing of Glaciers – Petri Pellikka& W. Gareth Rees
7. Principles of Glacier Mechanics – Roger LeB. Hooke
8. Glacial Lake Outburst Floods (GLOFs): Causes, Impacts and Mitigation – Edited by R.B.

Singh & D. Thakur (Springer),
9. Snow and Glacier Hydrology – Satya Singh (for Himalayan context)
10. Glacial Geology: Ice Sheets and Landforms – Matthew R. Bennett & Neil F. Glasser
11. Glacial Sedimentary Processes and Products – Edited by Michael J. Hambrey et al.
12. Periglacial Geomorphology – Hugh M. French.
13. The Cryosphere – Shawn J. Marshall (Part of the Princeton Primers in Climate series)
14. Climate Change and Glacial Hazards in the Indian Himalayas – R.K. Goyal (for case studies on GLOFs)
15. Sea Level Rise: History and Consequences – Bruce C. Douglas et al., Ice Sheets and Late Quaternary
16. Environmental Change – Martin J. Siegert
17. Glaciers: Climate, Hydrology and Geomorphology – Atle Nesje & Sveinn Brynjólfsson
18. Himalayan Glaciers: Hydrology and Hydrochemistr. D.P. Dobhal **(**Springer)
19. Glaciology and Glacial Geomorphology- Navodita Bhatnagar
20. Glacier Atlas of India- V.K. Raina and Deepak Srivastava

Course Code: P2AGTE405 **Course Title: Earthquake Geology**
Course Credit: 2 **Marks: 50**
Duration of Examination: 2½ hours **(Minor I-10, Minor II 10, Major 30)**

(Syllabus for the examination to be held in May 2027, May 2028 & May 2029)

Course Objectives: Earthquake Geology course aims to provide students with a complete knowledge and understanding of the geological processes and features associated with earthquakes. This course focuses on the mechanics of faulting, seismic cycles, and the identification of active tectonic structures. Students will learn to analyze surface expressions of seismic activity, such as fault ruptures and ground deformation. Through the application of techniques like paleoseismology, course equips students with the skills necessary for seismic hazard assessment and risk mitigation.

Course Outcomes: This course will help students to develop a comprehensive understanding of

- Geological processes underlying seismic activity
- Aanalyzing active fault systems, interpreting seismic records, and reconstructing the history of past earthquakes Assess seismic hazards and contribute to risk mitigation strategies through geological mapping and fault characterization.

Unit 1: Fundamentals of Earthquake Geology

1.1 Introduction to Earthquakes: Definition, causes, and classification of earthquakes**;** Historical earthquakes and their geological significance.
1.2 Introduction to Seismotectonic: Basics of plate tectonics and earthquake generation; Lithospheric deformation and stress accumulation.
1.3 Seismic Waves and Measurement: Types of seismic waves; instruments used for earthquake measurement, earthquake magnitude scales.
1.4 Stress and Strain in the Earth's Crust: Elastic rebound theory**;** Fault mechanics and rock deformation.

Unit 2: Fault Systems and Seismotectonics

2.1: Fault Types and Classification: Normal, reverse, strike-slip faults**;** Characteristics and behavior of active faults.
2.2 Seismic Cycle: Inter-seismic, co-seismic, and post-seismic phases**;** Fault segmentation and seismic hazard assessment.
2.3: Paleoseismology: Definition, goals, and significance; Field Techniques in Paleoseismology; Trenching, logging, and sampling methods.
2.4: Earthquake-Induced Landforms: Geomorphic markers**,** Surface ruptures, liquefaction, landslides**;** Case studies of earthquake-induced geomorphology.

Unit 3: Earthquake Hazards and Mitigation

3.1 Ground Shaking and Structural Damage: Effects of ground motion on infrastructure**;** Seismic building codes and retrofitting strategies.
3.2 Secondary Earthquake Hazards: Tsunamis, landslides, and soil liquefaction**;** Predictive models for secondary hazards.
3.3 Risk Assessment and Seismic Zoning: Mapping active seismic zones; Probabilistic hazard analysis.
3.4 Early Warning Systems and Preparedness: Earthquake forecasting methods; Emergency response strategies and community awareness.

Unit 4: Applications and advances in Earthquake Geology

4.1 Induced Seismicity and Anthropogenic Causes: Reservoirs, hydraulic fracturing, mining; Regulatory frameworks and monitoring.

4.2 Computational Seismology and Earthquake Simulation**:** Earthquake modeling and prediction algorithms**;** AI and machine learning applications in earthquake forecasting.

4.3 Case Studies of Significant Earthquakes**:** Analysis of notable earthquakes worldwide**;** Lessons learned from past seismic disasters.

4.4 Future Directions in Earthquake Research**:** Advances in earthquake geology and mitigation strategies**;** Role of interdisciplinary approaches in seismic studies.

Recommended Books:

1. Earthquake Geology. C. P. Rajendran, 2012 (latest edition)
2. Introduction to Seismology. Peter M. Shearer, 2009
3. An Introduction to Seismology, Earthquakes, and Earth Structure. Seth Stein and Michael Wysession, 2003 (2nd Edition)
4. Seismology and Plate Tectonics (Springer). R. K. Chadha, 2014
5. Seismic Waves and Sources. A. K. Ghosh, 1998
6. Earthquake Hazard and Seismic Risk Reduction. J. C. Paul and K. S. Valdiya, 2000
7. Seismology. D. S. K. Iyengar, 2001
8. Geology of Earthquakes. Robert S. Yeats, Kerry Sieh, and Clarence R. Allen, 1999
9. Plate Tectonics and Great Earthquakes. Lynn R. Sykes, 2019
10. Overview of Artificial Intelligence (AI) and Machine Learning (ML) in Seismology. Harendra Kumar Dadhich, 2023.

Course No.: P2AGRC406 **Title: Dissertation**
Credits: 16 **Maximum Marks: 400**

(Syllabus for the examination to be held in May 2027, May 2028 & May 2029)

The dissertation shall comprise field / laboratory work by a student. The allotment of specialization/ Supervisor shall be based on preference and merit (total marks obtained in Semester I & II). The number of students shall be distributed equally among the permanent faculty on the basis of merit and preference of students. The dissertation shall be evaluated by a board of Examiners comprising Head of the Department, Supervisor and an external examiner.