AC 27-2-13
Item no 4.65

UNIVERSITY OF MUMBAI

Syllabus for Sem III and Sem IV
Program: M.Sc.
Course: GEOLOGY

(Credit Based Semester and Grading System with effect from the academic year 2013–2014)

M.Sc. CREDIT SYSTEM WITH EFFECT FROM ACADEMIC YEAR 2013-2014

PROGRAM: M.Sc. II SECOND YEAR

COURSE: GEOLOGY

SEMESTER III THEORY

SEMESTER	PAPER CODE	PAPER	CREDITS	TOTAL CREDITS
III	PSGE301	GEOPHYSICAL PROSPECTING	2	08
	PSGE302	PALEONTOLOGY AND MICROPALEONTOLOGY	2	
	PSGE303	ELECTIVE I a) COAL GEOLOGY b) ENVIRONMENTAL GEOLOGY	2	
	PSGE304	ELECTIVE II a) PETROLEUM GEOLOGY b) MARINE GEOLOGY	2	
PRACTICAL				
III	PSGEP5	PSGE301 & 302	4	08
	PSGEP6	PSGE303 & 304	4	

SEMESTER IV THEORY

SEMESTER	PAPER CODE	PAPER	CREDITS	TOTAL CREDITS
IV	PSGE401	MINERAL ECONOMICS	2	08
	PSGE402	PLATE TECTONICS	2	
	PSGE403	ELECTIVE III a) OCEANOGRAPHY b) HYDROGEOLOGY	2	
	PSGE404	ELECTIVE IV a) STRUCTURAL ANALYSES b) GEOTECTONICS WITH REFERENCE TO INDIAN PLATE	2	
PRACTICAL				
III	PSGEP7	PSGE401 & 402	4	08
	PSGEP8	PSGE403 & 404	4	

M.Sc. Semester III and Semester IV GEOLOGY Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2013-2014
Semester III Detail Syllabus

Course Code	Title	Credits
PSGE301	Geophysical Prospecting	4
Unit I: Introduction and application 1. Geophysics in oil and mining industry 2. Relationship between exploration geophysics and basic sciences 3. Various methods of exploration for various minerals and their application 4. Methods of geophysical modelling and selection of exploration methods 5. Integration of geophysical data and case histories		
Unit II: Gravity and magnetic exploration 1. Fundamental principles of gravity prospecting 2. Earth's gravity and concept of isostasy 3. Instruments, field measurements and interpretation 4. Fundamental principles of magnetic prospecting 5. Earth's magnetism 6. Instruments, field measurements and interpretation 7. Introduction to airborne magnetic survey		
Unit III: Seismic prospecting 1. Seismic wave propagation 2. Earthquakes and structure of earth 3. Seismic reflection and refraction method 4. Instruments and field measurements 5. Processing and interpretation of seismic data. 6. Applications in petroleum industry		
Unit IV: Electrical prospecting methods and prospecting for radioactive minerals 1. Self-potential method and equipotential line method 2. Resistivity method 3. Telluric currents and naturally alternating magnetic fields 4. Induced polarization method 5. Fundamentals of radioactivity and detection of radiation 6. Common radioactive minerals and prospecting techniques 7. Examples of radioactivity survey		

Course Code	Title	Credits
PSGE302	Paleontology and Micropaleontology	4
Unit I: Paleontology 6. A general account of fossils, organic evolution and systematic paleontology. 7. Grade growth and spatial distribution of organisms. 8. Stratigraphy, paleontology and paleoecology.		
Unit II: Vertebrate fossils 8. Major subdivisions of vertebrates. 9. Outline of morphology and skeletal elements of vertebrates. 10. Geological history of vertebrates. 11. Dinosaurs 12. Evolution of horses and elephants 13. Primates and ancestry of man 14. Record of vertebrate fossils of India		
Unit III: Plant microfossils General morphology of spores and pollen, fossil seeds		
Unit IV: Micropaleontology 8. Introduction to micropaleontology 9. Record of microfossils from Phanerozoic rocks of India 10. Collection, preparation and preservation of microfossils (invertebrate) 11. Foraminifera: foraminifera test, ecology 12. Ostracoda: morphology, ornamentatio and orientation of carapace 13. Conodonts: characteristics of conodonts, origin 14. Radiolaria: applied micropaleontology, environmental significance		

Course Code	Title	Credits
PSGE303	Elective I: Coal Geology	4
Unit I: Origin of Coal Origin and mode of occurrence of coal, chemical and physical constituents of coal		
Unit II: Classification of Coal Classification of coal, structural features of coal seams		
Unit : III: Mining of coal Sampling of coal in mines and in the laboratory: prospecting for coal, methods of coal mining, washing and briquoting, utilization of coal, coal as a source of petroleum		
Unit : IV: Study of Indian coals A detailed study of Indian coal fields with reference to geology, grade of coal, economic reserves and future prospects, problems of the coal industry and its future prospects.		

Course Code	Title	Credits
PSGE303	Elective I: Environmental Geology	4
Unit I: Introduction 1. Introduction to environmental geology. 2. Management of natural resources.		
Unit II: Environment and climate 1. Air pollution and global climate changes. 2. Environmental controls for erosion, desertification and coastal degradation.		
Unit III: Geological hazards and environment 1. Geological hazards such as floods, landslides, earthquakes, volcanoes, glaciers and shoreline processes, their remedial measures. 2. Environmental impact of mining, dams, reservoirs, highways, their assessment and controls. Cleaner sources of energy.		
Unit IV: Man and environment 1. Industrial pollution, waste disposal, groundwater contaminations, river lake and marine pollution and their impact on human health. 2. Geological aspects of human health. Trace elements and health hazards.		

Course Code	Title	Credits
PSGE304	Elective II: Marine Geology	4
Unit I: Ocean Currents Waves, currents, Catastrophic waves from the sea Beaches, Continental Shelves		
Unit II: Landforms of the oceans Continental slopes, Trenches & Canyons		
Unit III: Ocean floor and tectonics Deep ocean floor and various topographic features- ridges, sea mounts Coral reefs		
Unit IV: Ocean sediments and mineral resources Sediments, mineral deposits of sea bed Man & ocean		

Course Code	Title	Credits
PSGE304	Elective II: Petroleum Geology	4
Unit I: Origin of Petroleum 1. Physical and chemical properties of petroleum 2. Origin of petroleum 3. Petroleum traps and reservoirs		
Unit II: Migration and prospecting of petroleum 1. Migration and accumulation of petroleum 2. Geophysical prospecting for petroleum 3. Drilling, logging and subsurface correlation		
Unit III: Sedimentary basins of world and oil belts 1. Oil belts of the world 2. Detailed study of the potential sedimentary basins and oil fields of India		
Unit IV: Petroleum industry of India 1. Petroleum and petrochemical industry in India 2. Synthesis of petroleum, India's position as regards to petroleum and natural gas and future prospects		

Course Code	Note: Practicals depend on the elective chosen.		
PSGEP5	Paleontology Hand identification of fossils from various Phylla (invertebrate fossils only) along with study of their evolution. ********** Micropaleontology Identification of micro fossils of planktic and benthic foraminifera, ostracoda, pteropoda and radiolaria	**4**	**8**
PSGEP6	Geophysical Prospecting Problems and maps related with gravity, electrical and seismic prospecting. ********** Ore Mineralogy Identification and study of origin and Indian occurrence of 20 ore minerals.	**4**	**8**

Semester IV Detail Syllabus

Course Code	Title	Credits
PSGE401	Mineral Economics	4
Unit I: Introduction and concepts 1. Mineral economics and its concepts 2. National Mineral Policy 3. India's status in mineral production		
Unit II: Distribution and mode of occurrence of ore minerals 1. Distribution, mode of occurrence and origin of building stones. Phosporite deposits, Placer deposits, REE, Strategic, critical and essential minerals. 2. Occurrence and distribution in India of metalliferous deposits: Base metals, Nickel, gold, solver, molybdenum, iron, manganese, aluminium, chromium.		
Unit : III: Indian deposits of non metals 1. Indian deposits of non-metals mica, asbestos, barytes, gypsum, graphite, apatite and beryl.		
Unit : IV: Distribution and mode of occurrence of industrial minerals and gemstones 1. Distribution mode of occurrence, origin of gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint ceramic and cement industry.		

Course Code	Title	Credits
PSGE402	Plate Tectonics	4
Unit I: Concept of Plate tectonics 1. Concept of tectonics on a sphere, mechanism of plate tectonics 2. Plates and plate boundaries. Relative and absolute plate motions		
Unit II: Continental drift and associated landforms 1. Ocean ridges. Continental drift. Hot spot and mantle plumes 2. Subduction zones. Transform and trancurrent faults.		
Unit : III: Meachanism of plate movements and ocean floor spreading 1. Driving mechanism for plate movement 2. Marine magnetic anomalies and sea floor spreading		
Unit : IV: Orogeny and Neotectonics 1. mountain belts and orogeny 2. Evolution of cratons 3. Indicators of neotectonic movements		

Course Code	Title	Credits
PSGE403	Elective III: Oceanography	4
Unit I: Origin Origin of the oceans, evidence for plate tectonics, plate boundaries, mid-oceanic ridges an mantle convection, sea floor spreading		
Unit II: Oceanography 1. Marine provinces: bathymetry, provinces of the ocean floor 2. Marine sediments: classification of sediments, neritic and pelagic deposits 3. Surface and subsurface marine resources		
Unit : III: Ocean circulation Surface currents, upwelling and downwelling, surface currents of the oceans, deep currents		
Unit : IV: Waves, currents and beaches 1. Wave characteristics, wind generated waves 2. Beaches and shoreline processes, estuaries, wetlands lagoons		

Course Code	Title	Credits
PSGE403	Elective III: Hydrogeology	4
Unit I: Introduction to hydrogeology 1. The hydrogeologic cycle 2. Formation of aquifer systems and tyoes 3. Occurrence and movement of groundwater, flownet analyses		
Unit II: Properties of rocks and groundwater 1. Hydrologic properties of rocks and their measurments 2. 2. Fluctuation of groundawater levels and causes 3. Recharge and discharge of groundwater		
Unit : III: Groundwater exploration 1. Groundwater exploration by geologic, hydrogeologic, remote sensing and geophysical methods. 2. Well hydraulics, tube well drilling techniques, desiging, development and pumping tests.		
Unit : IV: Chemical properties of groundwater 1. Groundwater chemistry and quality analysis 2. Groundwater resources of India, salinity, waterlogging and causes of water table declination and deteoriration of water quality.		

Course Code	Title	Credits
PSGE404	Elective IV: Geotectonics with reference to Indian Plate	4
Unit I: Interior of the earth Crust and interior of the earth, thrust movements: mechanics and consequences		
Unit II: Dynamics of faulting and folding Dynamics of srike slip faults, fold mechanism in mountain belts and orogeny, evolution of cratons		
Unit : III: Tectonics and sedimentation Tectonics of continental margins, tectonics and sedimentation		
Unit : IV : Deformation Deformation in metamorphism, geotectonic settings of igneous activities, Neotectnic movements.		

Course Code	Title	Credits
PSGE404	Elective IV: Structural Analyses	4
Unit I: Dynamic analysis, stress components and ellipsoid, response of rocks to stress		
Unit II: Mechanics of deformation, kinematic analysis: strain ellipsoid and displacement vectors		
Unit : III Determination of strain in deformed rocks, descriptive and geometrical analysis		
Unit : IV Crustal evolution of India: Himalayas, Indo-Gangetic Tracts, Peninsular India, Eastern & Western coastlines.		

Course Code	Details	**Credits**	**L/week**
PSGEP07	Ore microscopy: preparation of sample for ore petrography and Petrographic study of 20 polished ore samples	**4**	**8**
PSGEP08	Coal petrology and microscopy Megascopic study of coal. Microscopic study of coal pellets.	**4**	**8**

EXAMINATION

PROGRAM : M.Sc. Semester III and IV

THEORY EXAMINATION

INTERNAL (Continuous Assessment: 01 Assignment, 01 class test, viva, Seminar) : 40 Marks
END SEMESTER:
Theory End Semester Question Paper: 02 hours duration and 60 Marks
Instruction to Examiners : There will be 05 QUESTIONS of 12 MARKS each
Instruction to Candidates: All questions are Compulsory
Questions will be set from all topics for 12 MARKS with INTERNAL options
Question 1 based on unit 1
Question 2 based on unit 2
Question 3 based on unit 3
Question 4 based on unit 4
Question 5 based on units 1 to 4

Geological Fieldwork:

As a part of the practical course in the 4th semester, Long fieldwork in an area outside the Deccan flood basalts has to be carried out. The field work should be aimed at learning the techniques of geological mapping and use of field surveying instruments.

For the purpose of workload, field work may be considered as 4 lecture hours per week.

20 marks per practical course ie. 20 marks out of 100 in course PSGEP07 and 20 marks out of 100 in course USGEP08 are to be considered for fieldwork. The marks are for successfully attending the field work and submitting a field report based on individual work carried out on the fieldwork by the learner.

Out of the total of 40 marks for fieldwork, 20 marks are to be assigned by the field instructors for the actual work done during the fieldwork and 20 marks are assigned for the field report submitted by the individual learner.

The balance of 80 marks per practical course are for evaluation and assessment based on the practicals conducted through the course of the semester.

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M.Sc. Geology
SEMESTER III & IV: Recommended Reading

GEOPHYSICAL PROSPECTING

1. Dobrin, Milton B. (1960): Introduction to Geophysical Prospecting, McGraw-Hill Book Company, Inc.

2. Milsom, J. and Asger, E. (2011): Field Geophysics, 4th edition, Wiley and Sons Ltd.
3. Committee on Geodesy, National Research Council (1995): Airborne Geophysics and Precise Positioning: Scientific Issues and Future Directions, National Academics Press
4. Gadallah, M. and Fisher, R. (2009): Exploration Geophysics, Springer-Verlag Berlin Heidelberg.
5. Kalyan Kumar Roy (2008): Potential Theory in Applied Geophysics, Springer-Verlag Berlin Heidelberg.

PALAEONTOLOGY & MICROPALAEONTOLOGY

1. Blatt, Harvey, Middleton, Gerard & Murray, Raymond (1972) Origin of Sedimentary Rocks. Prentice-Hall, Inc., N.J.,U.S.A .
2. Clarkson, E.N.K. (1986) Invertibrate Palaeontology and Evolution. ELBS Allen & Unwin
3. Ellis Moore, R. C. Invertebrate fossils, latest Ed., McGraw Hill.
4. Jenkins, D.G. and Murray J.W., (1981) Stratigraphy of fossils foramimfera.
5. Muller, German (1967) Methods in Sedimentary Petrology. Hafner Publishing Co.
6. Pettijohn, F. J. (1984) Sedimentary Rocks, 3'« edition, CBS Publishers and Distributors, NewDelhi. ,
7. Prothero Donald R. & Schwab Fred (1996) An introduction to Sedimentary Rocks and Stratigraphy. W. H. Freeman and Co. New York.
8. Sengupta, Supriya (1994) Introduction to Sedimentology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Stow Dorrik A. V. (2005) Sedimentary rocks in the field. Mason Publishing Ltd., U.K.
10. Tucker, Maurice E. (2001) Introduction to Sedimentology. Blackwell Publishing, U.S.A.
11. Tasch, P., (1980) Paleobiology of Invertebrate , John Wiley.
12. Wright, Ramil & Boltovskoy, Esteban (1976) Recent Foraminifera. Dr. W. Junk b.v.-Publishers- The Hague. University Press, U.K.
13. Banner, F. T. and F. Jord, A.R., (1982) Aspects of micropaleontology. Allen and Unwin.
14. Bignot, G., (1985) Elements of micropaleontology. Graham and Trotman.
15. Cooper J.D., (1986) A trip through time: Principles of historical geology.
16. Dasgupta Amal (2005) An Introduction to Palaeontology. The World Press Pvt. Ltd., Kolkata.
17. Haq, B. and Boersma, A. (1980) Introduction to Marine Paleontology , Elsevier.
18. Horwood. Hughes, Norman F. (1994) The Enigma of angiosperm Origins. Cambridge
19. Jones, Daniel J. (1969) Introduction to Microfossils. Hafner Publishing Co. New York.

20. Raup, David M. & Stanley, Steven M. (1985) Principles of Palaeontology. CBS Publishers and Distributors.. New Delhi.
21. Tucker, V.C.T. & Noeld, E.W. (1985) Palaeontology Pergaman Press.

ENVIRONMENTAL GEOLOGY

1. Aharma, V. K., (1986) Geomorphology Earth surface processes and form McGraw Hill
2. Chorley, R. J., (1984) Geomorphology Methuen.
3. Drury, S. A., 1986, Image Interpretation in Geology Allen & Unwin Inc U K
4. Selby, M.J. (1996) Earths Changing Surface. Oxford University Press UK
5. Thornbury w. D., (199J) Principles of Geomorphology Wiley Eastern Ltd., New Delhi
6. Valdiya, K. S (1987) Environmental Geology - Indian Context. Tata McGraw Hill new Delhi.
7. Keller, E.A., (2000) Environmental Geology latest Ed., 'Shales E. Merril Publishing Co.,Columbus, Ohio.
8. Montgomery, C, (1984) Environmental Geology John Wiley and Sons, London.
9. Bird, Eric (2000) Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore.
10. Hails, John R. (1977) Applied Geomorphology. Elsevier Scientific Publishing Co.New York.
11. Liu, B.C. (1981) Earthquake Risk and Damage Westview.

COAL & PETROLEUM GEOLOGY

1. Coal by E.S.Moore
2. Coal Geology by Van Krevelyn & Schuyer
3. Petroleum Geology by A.I. Levorsen
4. Courses in Mining Geology by R.N.P Arogyaswaml
5. Industrial Minerals and Rocks of India by S.Deb
6. Coal deposits of India by N.L.Sharma

MINERAL ECONOMICS

1. Industrial Minerals & Rocks of India by S. Deb
2. Mineral Economics by Sinha & Sharma
3. Ore deposits of India by Gokhale and Rao
4. Courses in Mining Geology by R.N.P. Arogyaswami

PLATE TECTONICS

1. Fowler, C.M.R. (2005) The Solid Earth: An Introduction to Global Geophysics, 2nd edition, Cambridge University Press, U.K.
2. Lerman, A., (1979) Geochemical Processes water & Sediment Environment. John Wiley.
3. Pickard, G.K. & Emeegy, W.J., (1982) Physical Oceanography Pergaman.

4. Seibolld, E. & Bergen, W.H., (1982) The Sea Floor. Springer.
5. Thurman, Harold V. & Trujillo, Alan P. (1999) Essentials of Oceanography, 6th edition Prentice-Hall Asia Pte Ltd., Singapore.
8. Wyllie, P.J. (1971) The Dynamic Earth. John Wiley and Sons, Canada.

OCEANOGRAPHY

1. Abarbanel, H.D.I. & Young, W.R., (1987) General Circulation of the Ocean. SpringerVerlag.
2. Bishop, J.M., (1984) Applied Oceanography John Wiley.
3. Devoy, R.J.N., (1987) Sea Surface Studies Croom Helm.
4. Gross, M. G. (1986) Oceanography. Prentice-Hall Asia Pvt. Ltd., Singapore.
5. Shepard, P.P., (1983) Submarine Geology. Harper and Row.
6. Siddhartha, K. (1999) Oceanography - A brief Introduction. Kisalaya Publications Pvt.Ltd., New Delhi.
7. Sverdrup, Keith A., Duxbury, Alison B. & Duxbury, Alyn C. (2006) Fundamentals of Oceanography, 5lh edition, McGraw Hill Higher Education, New Delhi.
8. Pinet, Paul R. (2006) Invitation to Oceanography. 4th edition, Jones and H.irlott Publishers, London.
9. Pirie, Gordon R. ed. ((1976) Oceanography: Contemporary Readings In Ocean Sciences;2nd edition, Oxford University Press, U.K.
10. Thurman, H.V., (1983) Essentials of Oceancfcraphy. Mecill.
11. Ocean Science - Readings from Scientific American, 1977, Scientific American Inc., San Francisco, Calfornia.

HYDROGEOLOGY

1. Nath, Sankar Kumar, Patra, Hari Pada, & Shahid, Shamsuddin [2000] Geophysical Prospecting for Groundwater. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Mazof s, E., (1988) Applied Chemical Groundwater Hydrology McGill.
3. Ingebritsen, Steve, Stanford, Ward & Neuzil, Chris (2006) Groundwater in Geologic Processes. 2nd edition, Cambridge University Press, U.K.
4. Assad, Fakhry, LaMoreaux, Phillip E., & Hughes, Travis H. ed. (2003) Field methods for Geologists and Hydrogeologists. Springer-Verlag, Berlin.
5. Brassington, R., (1988) Field Hydrogeology John Wiley & Sons, Chichester.
6. Todd., D.K. (1995) Groundwater Hydrology John Wiley & Sons, London.
7. Walton, W.C.Groundwater Resource Evaluation latest Ed., McGraw Hill.
8. Micheal, P., (1985) Introduction to Groundwater George Allen & Unwin, London.
9. Fetter, C.W., (1994) Applied Hydrogeology MacMillan Pub. Comp. New York.
10. Ragunath, H.M., (1992) Groundwater Wiley Eastern Ltd. New Delhi.
11. Bouwer, Herman (1978) Groundwater Hydrology. McGraw Hill, Inc., New Delhi.