PARUL UNIVERSITY - FACULTY OF SCIENCES

DEPARTMENT OF PETROLEUM ENGINEERING

PROPOSED SYLLABUS FOR 1st SEMESTERM.Sc. PROGRAMME

INTRODUCTION TO MINING

(SUBJECT CODE: 11217101)

Type of Course: Master of Science(Petroleum Mining)

Prerequisite: Fundamental Knowledge of mines and mining.

Rationale: This particular course introduces the terminology of mines and mining. Student will be learningthe primary aspects of mining and occurrence of mines.

Teaching and Examination Scheme:

Teaching Scheme (h/week)				Examination Scheme							
				Internal Marks			External Marks		Passing Marks (Theory + CE)	Passing Marks (Practical)	Total Marks
Lect	Lab	Tut	Credit	T	P	CE	T	P	Int. + Ext.	Int. + Ext.	
4	0	0	4	20	-	20	60		50		100

Lect -Lecture; **Tut-** Tutorial; **Lab-**Laboratory; **T-** Theory; **P-**Practical;

Content:

Sr. No.	Topic	Weightage in %	Teaching Hrs.
1.	***Introduction*** Surface mining - basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Deposits amenable to surface mining vis-à-vis excavation characteristics; Surface mining unit operations; Surface mining systems vis-à-vis equipment systems – classification, applicability, advantages and disadvantages.	25	15
2.	**Mining** – definition and economic importance; Mine – definition, different types and classification; Mine life cycle; Mineral deposit – different types and their classification; Mineral resources of India; Modes of entry to a mine – shaft, incline, decline, adit and box-cut. Overview of surface mining: Types of surface mines, unit operations, basic bench geometry, applicability & limitations and advantages & disadvantages. Overview of underground mining: Different coal mining	25	15

Sr. No.	Topic	Weightage in %	Teaching Hrs.
	methods and their applicability & limitations; Different metal mining methods and their applicability & limitations; Basic concepts of transportation, ventilation, illumination and support in underground mines.		
3.	**Mining of developed coal seams and dimensional stones** Mining of developed coal seams: Problems associated; Methods of working. Dimensional stones: Types, occurrences and uses; Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.	25	15
4.	**Opening up of deposits** Box cut – objective, types, parameters, methods; Factors affecting selection of box cut site; Production benches – formation, parameters and factors affecting their selection.	25	15

Outcome:

1. Basic concepts of mining and introduction to mining operations.
2. Mineral resources of India, Types of mines and mining methods.
3. Mining of coal seams, methods of working and building stones.
4. Actual mining process for extraction of mineral resources.

References:

Arogyaswamy, R N P. “Courses in mining geology”. Oxford & IBH Publishing Co. Pvt. Ltd.
Forrester, James Donald. “Principles of field and mining geology”. John Wiley & Sons Inc.
Howard L. Hartman, Jan M. Mutmansky.“Introductory Mining Engineering”. John Wiley &Sons Inc.
Marat Abzalov “Applied Mining Geology”. Springer.

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DEPARTMENT OF PETROLEUM ENGINEERING

PROPOSED SYLLABUS FOR 1st SEMESTER M.Sc. PROGRAMME

SURFACE MINING

(SUBJECT CODE: 11217102)

Type of Course: Master of Science(Petroleum Mining)
Prerequisite: Exposure to the mining types and ore deposits.

Rationale: Students will learn mainly about the classification of mining and techniques used in surface mining of mineral resources like coal and metals.

Teaching and Examination Scheme:

Teaching Scheme (h/week)				Examination Scheme							
				Internal Marks			External Marks		Passing Marks (Theory + CE)	Passing Marks (Practical)	Total Marks
Lect	Lab	Tut	Credit	T	P	CE	T	P	Int. + Ext.	Int. + Ext.	
4	0	0	4	20		20	60		50		100

Lect -Lecture; **Tut-** Tutorial; **Lab-**Laboratory; **T-** Theory; **P-**Practical;

Content:

Sr. No.	Topic	Weightage in %	Teaching Hrs.
1.	**Preparation for excavation** Ripper: Types, classification, applicability and limitations; Method and cycle of operation; Estimation of output; Concept of rippability. Estimation of number of drills required for a given mine production.	25	15
2.	**Discontinuous/cyclic methods of excavation and transport** Shovel-dumper operation: Applicability and limitations of electric shovel, hydraulic excavators and dumpers; Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other heavy earth moving machines) required for a given mine production; Method of work for sub-surface bedded and massive deposits and for hilly massive deposits by shovel – dumper combination. Dragline operation: Applicability and limitations, different modes of operation Scrapers: Applicability and limitations, various types; Method and cycle of operation; Dozers: Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation.	25	15
3.	**Continuous methods of excavation and transport** Bucket wheel excavators: Applicability and limitations; Types and principle of operation; Continuous surface miners: Types, classification, applicability and limitations; Principles of operation; Operational methods –	25	15

Sr. No.	Topic	Weightage in %	Teaching Hrs.
	classification; Conveyors: Shiftable and high angle conveyors; Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation.		
4.	**Slopes in surface mines** Types of mine slope – highwall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes; Slope stability assessment techniques; Waste dumps - types and formation methods; Slope protection, stabilization and monitoring.	25	15

Outcome:

1. The preparation of excavation, limitations, operation cycle of mines and estimation.
2. Methods of excavation in surface mining, transport and various equipment required for operations.
3. Continuous methods of mining and transport – types and classification.
4. The slope of mines – slope failure and factors influencing stability.

References:

Arogyaswamy, R N P. “Courses in mining geology”. Oxford & IBH Publishing Co. Pvt. Ltd.
Forrester, James Donald. “Principles of field and mining geology”. John Wiley & Sons Inc.
Howard L. Hartman, Jan M. Mutmansky. “Introductory Mining Engineering”. John Wiley and Sons Inc.
Marat Abzalov “Applied Mining Geology”. Springer.

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DEPARTMENT OF PETROLEUM ENGINEERING

PROPOSED SYLLABUS FOR 1st SEMESTER M.Sc. PROGRAMME

MINERALOGY AND PETROLOGY

(SUBJECT CODE: 11217103)

Type of Course: Master of Science (Petroleum Mining)

Prerequisite: Fundamental knowledge of minerals and ores.

Rationale: The course imparts knowledge on the types of minerals and ores found in the crust of earth, their classification and importance.

Teaching and Examination Scheme:

Teaching Scheme (h/week)				Examination Scheme							
				Internal Marks			External Marks		Passing Marks (Theory + CE)	Passing Marks (Practical)	Total Marks
Lect	Lab	Tut	Credit	T	P	CE	T	P	Int. + Ext.	Int. + Ext.	
4	2	0	5	20	20	20	60	30	50	25	150

Content:

Sr. No.	Topic	Weightage in %	Teaching Hrs.
1.	*Mineralogy* Minerals: Physical and chemical properties; Crystal, crystal classes and systems; Classification of minerals and properties of common silicate minerals (Quartz, Feldspar, Pyroxene, Amphibole, Garnet, Olivine, Mica), sulphides (Pyrite, Chalcopyrite, Galena, Sphalerite) and oxides (Haematite, Magnetite, Chromite, Pyrolusite, Psilomelane).	25	15
2.	*Petrology* Igneous rocks: Magma and lava, extrusive and intrusive forms, textures; Classification and description of some common igneous rocks (Granite, Dolerite, gabbro, Basalt, Rhyolite, Pegmatite). Sedimentary rocks: Sedimentation processes; Classification and description of some common sedimentary rocks (Conglomerate, Sandstone, Shale, Limestone). Metamorphic rocks: Processes of metamorphism, textures and structures of metamorphic rocks; Classification and description of some common metamorphic rocks (Slate, Phyllite, Schist, Gneiss, Quartzite, Marble).	25	15
3.	Mineralogy, classification and genesis of ore deposits associated with orthomagmatic ores of ultramafic-mafic rocks; Ores of felsic-silicic igneous rocks; Ores of sedimentary affiliation - biochemical, chemical and clastic sedimentation, placers and residual concentration deposits; Ores of metamorphic affiliations.	25	15
4.	Concept of ore bearing fluids, their origin and migration; Wall rock alteration; Structural, physicochemical and stratigraphic controls of ore localization; Ore deposits in relation to plate tectonics; Organic matters in ores and their significance; Fluid inclusions in ore - principles, assumptions, limitations and applications.	25	15

List of Experiments for LAB

1. Study of physical properties of the following minerals:
   (A) Rock forming minerals: Talc, Gypsum, Calcite, Fluorite, Feldspar, Muscovite, Biotite, Quartz, Beryl, Tourmaline, Corundum, Kyanite, Serpentine, Garnet and Sillimanite.
   (B) Ore minerals: Haematite, Magnetite. Chalcopyrite, Malachite, Azurite, Chromite, Bauxite, Pyrolusite, Psilomelane, Sphalerite, Galena
2. Study of common rocks with reference to their textures and mineral composition:
   (A) Igneous Rocks: Granite, Syenite, Gabbro, Basalt, Dolerite, Lamprophyre, Aplite, Pegmatite.
   (B) Metamorphic Rocks: Slate, Schists, Gneisses, Quartzite, Marble, Amphibolite, Charnockite.
   (C) Sedimentary Rocks: Conglomerate, Sandstone, Shale, Carbonaceous Shale, Coal, Limestone.

Outcome:

1. Introduction to different rock forming minerals and their classification.
2. Three different type of rocks and their process of formation and important rocks.
3. Mode of occurrence and genesis of ore deposits.
4. Ore bearing fluids, fluid inclusions and relation between plate tectonics and ore deposits.

References:

Klein, Cornelis and Hurlbut Cornelius “Manual of mineralogy (after James D Dana)” John Wiley & Sons.

Wade, Alton and Mattox, Richard B “Elements of crystallography and mineralogy” Oxford and IBH Publishing Co. Pvt. Ltd.

Vehoogen, John and Turner, Francis J. “Igneous and metamorphic petrology” CBS Publisher & Distributors

Philpotts, Anthony R. “Principles of Igneous and metamorphic petrology” Prentice-hall of India

Folk , Robert L. “Petrology of sedimentary rocks” Hemphill Publishing Co.

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DEPARTMENT OF PETROLEUM ENGINEERING

PROPOSED SYLLABUS FOR 1st SEMESTER M.Sc. PROGRAMME

GEOLOGY FOR PETROLEUM ENGINEERS

(SUBJECT CODE: 11217104)

Type of Course: Master of Science (Petroleum Mining)

Prerequisite: Fundamentals of Geoscience terminologies and processes.

Rationale:Students will learn the importance and role of geoscience in petroleum exploration and mining. This course is about the fundamental processes those are important for the prospecting of natural reserves.

Teaching and Examination Scheme:

Teaching Scheme (h/week)				Examination Scheme							
				Internal Marks			External Marks		Passing Marks (Theory + CE)	Passing Marks (Practical)	Total Marks
Lect	Lab	Tut	Credit	T	P	CE	T	P	Int. + Ext.	Int. + Ext.	
3	0	0	3	20	-	20	60	-	50	-	100

Lect -Lecture; **Tut-** Tutorial; **Lab-**Laboratory; **T-** Theory; **P-**Practical;

Content:

Sr. No.	Topic	Weightage	Teaching hours
1.	Application of Micropaleontology in hydrocarbon exploration. Geochemical study of microfossil tests (stable isotopes and elemental composition) and its application in paleoceanography and paleoclimatology and tracing history of marine pollution. Determination and correlation of paleofacies by microfossils; Interpretaion of sea floor tectonism from micropaleontological evidence.	25	15
2.	Principles of stratigraphy; Concepts of palaeontology; Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils; Broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India	25	15
3.	*Structural Geology* Interpretation of topographic (structural) maps; Attitude of planar and linear structures; Effects of topography on outcrops. Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Forms of igneous intrusions - dyke, sill and batholith. Effects of folds and fractures on strata and their importance in exploration activities.	25	15
4.	Approaches to measurement of geological time; Concept of sequence stratigraphy; brief ideas of magnetostratigraphy, and event stratigraphy and stratigraphic correlation	25	15

Outcome:

1. Applications of micropalaeontology in palaeoceanography and palaeoclimatology.
2. Principles of stratigraphy, index fossils, important coal belts and oil fields of India.
3. Study of structural maps, features like folds, faults and igneous intrusions.
4. Concept of sequence stratigraphy and stratigraphic correlation.

References:

Russell, William L. "Principles of petroleum geology" McGraw - Hill Book Company Inc.

Brooks, B. T. and Kurtz, S. S. "The chemistry of petroleum hydrocarbons" Reinhold Publishing Corporation, York

Nagy, Bartholomew and Colombo, Umberto. "Fundamental aspects of petroleum geochemistry" Elsevier publishing co., Amsterdam

Roberts, A. "Geological Structures and Maps: a course in interpretation with applications for civil & mining engineers" Cleaver-hume press, London.

R C Selley "Elements of Petroleum Geology" Academic Press.

R.E. Chapman "Petroleum Geology - Developments in Petroleum Science 16" Elsevier, Academic Press.

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DEPARTMENT OF PETROLEUM ENGINEERING

PROPOSED SYLLABUS FOR 1st SEMESTER M.Sc. PROGRAMME

PETROLEUM FORMATION EVALUATION

(SUBJECT CODE: 11217105)

Type of Course: Master of Science (Petroleum Mining)

Prerequisite: Basics of Petroleum Geology and petro-physical properties.

Rationale: Students will learn about the various petro-physical properties and well loggingtechniques in this course. The interpretation and analysis of different types of logs and their uses are the most important topics in this course.

Teaching and Examination Scheme:

Teaching Scheme (h/week)	Examination Scheme				
	Internal Marks	External Marks	Passing Marks (Theory + CE)	Passing Marks (Practical)	Total Marks

Lect	Lab	Tut	Credit	T	P	CE	T	P	Int. + Ext.	Int. + Ext.	
4	0	0	4	20	0	20	60	0	50	0	100

Lect -Lecture; **Tut-** Tutorial; **Lab-**Laboratory; **T-** Theory; **P-**Practical;

Content:

Sr. No.	Topic	Weightage in %	Teaching Hrs.
1.	Petrophysical measurements to sub-surface engineering.- petrophysical properties such as lithology, porosity, water saturation, permeability and density; measuring and evaluating rock properties by acquiring well log measurements; core measurements and seismic measurements	25	15
2.	Indirect Methods: SP and resistivity logs, radioactive logs, acoustic logs (principles, types of tools, limitation and applications). Evaluation of CBL/ VDL, USIT, SFT, RFT. Production Logging: Introduction, type of tools, principles, limitations and applications.	25	15
3.	Special Type of Logging Tools: Casing inspection tools (principles, application and limitation), Formation micro scanner (FMS), DSI, NMR logging principles. Logging in high-angle wells	25	15
4.	Log Interpretation and Analysis Techniques. a) Standard log interpretation methods. b) Cross-plotting methods: neutron-density, sonic-density and sonic-neutron etc. c) Clean sand interpretation d) Concepts of invasion – RXO, Tornado charts. e) Shaly sand interpretation.	25	15

Outcome:

1. Petro-physical measurements and properties along with well log and core measurements.
2. Different types of well logs and production logging tools and principles.
3. Special Type of logging tools, casing inspection tools and logging in inclined wells.
4. Interpretation of logs and analysis techniques, cleans and shaly sand interpretation.

References:

Toby Darling (2005) “Well Logging and Formation Evaluation (Gulf Drilling Guides)” Gulf Professional Publishing.

S. Boyer and Mari J. L. (1997) “Seismic Surveying and Well Logging: Oil And Gas Exploration Techniques (Oil and Gas Exploration Techniques)” Editions Technip.

Alun Whittaker (1985) "Formation Evaluation: Geological Procedures" Series: The EXLOG Series of Petroleum Geology and Engineering Handbooks. Springer Netherlands.
Richard M. Bateman (2012) "Open hole Log Analysis and Formation Evaluation". Society of Petroleum Engineers.

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DEPARTMENT OF PETROLEUM ENGINEERING

PROPOSED SYLLABUS FOR 1st SEMESTER M.Sc. PROGRAMME

METHODS OF APPLIED MATHEMATICS

(SUBJECT CODE: 11217106)

Type of Course: Master of Science (Petroleum Mining)

Prerequisite: Understanding of differential equations, integrals and functions.

Rationale: This course is aimed to help the students to solve the differential equations and to make understandthem the basic concepts of Laplace transforms. The objective is to develop skills in solving complex numericals for better understanding and implication in modelling and simulations.

Teaching and Examination Scheme:

Teaching Scheme (h/week)				Examination Scheme							
				Internal Marks			External Marks		Passing Marks (Theory + CE)	Passing Marks (Practical)	Total Marks
Lect	Lab	Tut	Credit	T	P	CE	T	P	Int. + Ext.	Int. + Ext.	
4	0	0	4	20	-	20	60	-	50	0	100

Lect -Lecture; **Tut-** Tutorial; **Lab-**Laboratory; **T-** Theory; **P-**Practical;

Content:

Sr. No.	Topic	Weightage in %	Teaching Hrs.
1.	*Complex Variables:* Limit, continuity and differentiability of function of complex variables. Analytic functions. Cauchy-Riemann's equations, Cauchy's integral theorem, Morena's theorem, Cauchy's integral formula, Taylor's and Laurent's series, singularities, Residue theorem; Contour integration.	25	15
2.	*Special Functions:* Solution of Bessel equations, recurrence relations and generating	25	15

Sr. No.	Topic	Weightage in %	Teaching Hrs.
	function for Jn(x), orthogonal property and integral representation of Jn(x). Solution for Legendre equation, Legendre polynomial, Rodrigue's formula, orthogonality property and generating function for Pn(x).		
3.	*Laplace transform:* Laplace transforms of simple functions, properties of Laplace transform, t-multiplication and t-division theorems, Laplace transforms of derivatives, integrals and periodic functions. Inverse Laplace transform and its properties, convolution theorem. Use of Laplace transform in evaluating complicated and improper integrals and solution of ordinary differential equations related to engineering problems.	25	15
4.	*Partial Differential Equations:* Classification of partial differential equations, solution of one dimensional wave equation, one dimensional unsteady heat flow equation and two dimensional steady heat flow equation by variable separable method with reference to Fourier trigonometric series.	25	15

Outcome:

1. Limit, continuity, differentiability of complex variables and analytic functions.
2. Bessel equations, Legendre equation, Rodrigue's formula.
3. Laplace transform- properties and use in evaluating complicated integrals, t-division theorems.
4. Partial differential equations, one/two dimensional heat flow.

References:

Mahan, Gerald D (2002) "Applied Mathematics". Springer.

Street, R O. "Examples in applied mathematics". Methuen & Co.

Mane, B.V. "A Textbook of applied mathematics". Everest Publication.

Joel L. Schiff (1999) "Laplace Transformation: Theory and Applications". Springer.