## M. Tech. Petroleum Exploration

### Credit Structure

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Semester I</th>
<th>Semester II</th>
<th>Semester III</th>
<th>Semester IV</th>
<th>Total Credits</th>
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<tbody>
<tr>
<td>Core Courses</td>
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<td>---</td>
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<tr>
<td>Dept. Electives</td>
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<tr>
<td>Institute Electives</td>
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<tr>
<td>Courses from outside the Department</td>
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<tr>
<td>Lab Course</td>
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<tr>
<td>Seminar</td>
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<tr>
<td>R&amp;D Project</td>
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<tr>
<td>Communication Skill</td>
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<tr>
<td>Training (P/NP)</td>
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<td>Course Credits</td>
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<td>78+4</td>
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<tr>
<td>Project Credits</td>
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<td>Total Credits</td>
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<td>51</td>
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<td>162+4</td>
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### Course Outline

**First semester:** (Total credits 39+4)

**Second Semester:** (Course credits= 30, R&D Project credits=9, Project credits 12; Total course credits= 51)

**Third Semester- Project Credits 30**

**Fourth Semester- Project Credits 42**

**Total credits: 162 +4**
M. Tech. Petroleum Exploration

Course outline

First semester: (Total credits 39+4)
Core courses (one course compulsory)
Petroleum Geology and Exploration Methods

Elective courses (any four)
Exploration Geophysics
Basin Analysis and Applied Micropaleontology
Remote Sensing, GIS and GPS
Structural Geology and Subsurface Geological Mapping
Well-site Geology and Formation Evaluation
Seismic Data Processing & Seismic Stratigraphy
Oilwell Drilling Technology

Lab Course: Methods in Structural Geology 5
Seminar: 4
Communication skills: +4

Second Semester: (Total course credits 39 + project credits 12)
Core course: (One compulsory course)
Well logging

Department Electives: (Any two)
Any two from below
Reservoir Sedimentology
Petroliferous Basins of India
Sequence Stratigraphy in Petroleum Exploration
Petrophysics

R&D Project
Six weeks program either in ONGC or BG Lab.

Courses Outside Department (may be dropped and in place one more department elective can be given)
Energy resources Economics and Environment

Institute Elective (one)
Cost Benefit Analysis
Environmental Planning and Development
Project Management
Human Resource Development
Environmental Change and Sustainable Development
Remote Sensing for Sub-Surface Water Resources
Natural Disaster Assessment and Management
**M. Tech. Petroleum Exploration**

**Course details**

**Petroleum Geology and Exploration Methods (3 0 0 6)** (hours per week, Lecture=3, Tutorial=0, Practical=0; Credit=6)


**Texts/References**


**Exploration Geophysics (3 0 0 6)**

Seismic Exploration Theory and geometry of seismic waves, seismic velocity, characteristics of seismic events, seismic sources and equipment. Reflection and refraction field method. Data processing-fourier analysis, convolution, correlation, filtering, velocity analysis, stacking and migration, seismic stratigraphy seismic sequences, facies and reflection character analysis, hydrocarbon indicators, seismic interpretation. Gravity and Magnetic methods Principles and methods of gravity and magnetic prospecting, instrumentation, data processing, interpretation with case studies.

**Texts/References**

GS 679 Basin Analysis and Applied Micropalaeontology (3 0 0 6)

Basin classification and their characteristics; tectonic framework of basins and their architecture; economic significance of basin analysis; facies concept, process-response models and interpretation of sedimentary environments; carbonate and clastic facies models; seismic facies and stratigraphy; well-log facies application in sequence stratigraphy; sequence stratigraphy; stratigraphic correlation; basin mapping structure and isopach contouring, lithofacies and biofacies maps, preparation of stratigraphic cross-sections and palaeogeographic synthesis; regional and global stratigraphic cycles. Surface and subsurface sampling methods for micropalaeontological studies; brief description of major microfossil groups used in hydrocarbon exploration; palaeoenvironmental interpretation using microfossils; biostratigraphic classification, dating and correlation of stratigraphic sequences, standard planktonic foraminiferal zones; application of micropalaeontology in sequence stratigraphy; case studies of Indian sedimentary basins.

Texts/References

Remote Sensing, GIS and GPS (3 0 0 6)
Fundamentals of remote sensing, digital image data formats, image rectification and restoration techniques - geometric correction, radiometric correction and noise suppression, image histograms, density slicing, image enhancement techniques contrast manipulation, spatial filtering and edge enhancement, multi-image manipulations spectral ratioing, vegetation indices, principal components analysis, multi-spectral image classification involving supervised and unsupervised algorithms, Recent developments and applications.
Fundamentals of GIS, vector, raster and attribute data models, vector and raster data structure, spatial data input and editing, visualization and query of spatial data, spatial data transformations, spatial analysis, case studies of geological applications, current issues and trends in GIS. Principles of global positioning systems (GPS) and its applications.
Structural Geology and Subsurface Mapping  (3006)


Texts/references

Well-site Geology and Formation Evaluation  (3006)

Concept of formation evaluation and log interpretation. Response of logging tools and borehole effect on log measurements. Logging practices, log quality control and environmental correction on well log measurements. Lithology plots. Saturation, irreducible saturation and permeability studies from well logs. Shaly sand analysis. Cementing quality monitoring. Theory of transient well testing, use of pseudopressure in gas well testing. Constant bottomhole pressure tests. Practical aspects of design and performance of field tests. Analysis of transient pressure data, effects of boundaries,
reservoir heterogeneity, multiphase flow. Study of production, DST and formation interval tests. Pulse testing and multiwell tests.

**Texts/References**


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**Seismic Data Processing and Seismic Stratigraphy (3006)**

Review of techniques of seismic data acquisition for land and offshore areas using impulsive and vibratory energy sources. Nature of seismic records and recording parameters. Fundamentals of time series analysis, sampled time series, sampling theorem and aliasing, synthesis and analysis of waves and Fourier transform, spectral analysis and filtering. Basic data processing sequence, first-order data processing steps from treatment of field data to intermediate stacks, marine and land seismic data. Processing refinements, essential refinements to improve the seismic image including relative amplitude recovery, deconvolution, velocity analysis and residual statistics. Advanced processing, wavelet processing, filter design, velocity filtering and other sophisticated techniques for data enhancement. Migration techniques, generalized inversion, refraction statistics, and seismic tomography. Seismic modeling, forward modeling, interpretive processing. Basic concepts, definitions and objectives of seismic stratigraphy, Brief review of seismic data processing for stratigraphic needs, wavelet processing. Stratigraphic patterns in seismic data, seismic reflection character analysis, amplitude and continuity, seismic interpretations, interpretation procedures for stratigraphic traps. Seismic sequence analysis - the geologic models, picking of unconformities and mapping of seismic sequence. Seismic Facies analysis- seismic reflection characteristics, simple and complex reflection configuration, interpretation of depositional environment and lithology, eustatic sea level changes, seismic modeling - introduction, forward and inverse modeling concepts. Seismic data interpretation.

**Texts/References**


Oilwell Drilling Technology (3006)


Texts/References

Methods in Structural Geology (0135)
Practical strain analysis: Displacement, strain ellipse, heterogeneous strain, displacement vector, Strain measurement with respect to a line and angle, stereographic analysis, strain in three dimension, planar and linear, strain rate, palaeostress measurement, pressure gauge, rheology gauge, 3-D Structural Geology: surface and subsurface map interpretation, balanced cross section, U-stage, Special techniques in structural analysis.

Texts/References
Well logging (3006)

Texts/References

Reservoir Sedimentology (3006)
Facies diagnosis and facies models of carbonates, classification of carbonate rocks; standard microfacies types; carbonate diagenesis; porosity evolution and diagenesis in sequence stratigraphic framework; pore geometry and performance of reservoir rocks; relationship of depositional environments with the development of reservoirs. Properties of sandstone, environment of deposition of sandstone; sandstone classification, porosity evolution in course of sandstone diagenesis; characteristic reservoir morphology and criteria for recognition of eolian, fluvial, coastal, deltaic, shelf and basin sandstone bodies; reservoir heterogeneity; petrophysical analysis using logs; reservoir sedimentology of Indian petroliferous basins.

Texts/References
Petroliferous Basins of India 3 0 0 6

Types of petroliferous basins, relations between basin type and hydrocarbon richness; classification of petroliferous basins of India; Detailed study of stratigraphy, structure and petroleum geology of Assam shelf, Cambay and Bombay offshore basins; Potential source rocks, reservoir rocks and exploration targets of Krishna-Godavari, Mahanadi, Cauvery, Bengal, Kutch, Saurashtra and Rajasthan Basins; Current status of exploration and prospects in Indo-Gangetic plains, Kashmir valley and Vindhyan Basins.

Texts/References

Sequence Stratigraphy in Petroleum Exploration

Historical developments of sequence stratigraphy, key concepts, transgressions and regressions. Sequence stratigraphic surfaces, types of stratal terminations, Systems tract: Lowstand systems tract, Highstand systems tract, Falling stage systems tract, Regressive systems tract. Hierarchy of sequences and sequence boundaries; Sequence stratigraphy of hydrocarbon reservoirs; Applications to source rocks exploration. Application of sequence stratigraphy in Clastic and carbonate depositional systems. Case studies showing applicability of sequence stratigraphic concepts for understanding petroleum plays.

Texts/References

Texts/references

EN 606 (3006)
Energy Resources, Economics and Environment
Overview of World Energy Scenario: Dis-aggregation by end-use, by supply Fossil Fuel Reserves- Estimates, Duration Overview of India’s Energy Scenario- Dis-aggregation by end-use, by supply, reserves Country Energy Balance Construction- Examples. Trends in energy use patterns, energy and development linkage.
Environmental Impacts of energy use - Air Pollution - SOx, NOx, CO, particulates Solid and Water Pollution, Formation of pollutants, measurement and controls; sources of emissions, effect of operating and design parameters on emission, control methods, Exhaust emission test, procedures, standards and legislation; environmental audits; Emission factors and inventories Global Warming, CO2 Emissions, Impacts, Mitigation Sustainability, Externalities, Future Energy Systems.

Texts/References