

# M.Tech Oil and Gas Engineering (OGE)

A Full-Time Residential, face to face, Degree Course (24 months) offered in academic articulation with UPES, Dehradun ([www.upes.ac.in](http://www.upes.ac.in))

{The world's rapidly growing and varied energy needs in an immense global market is the essence of the challenge we face today. Energy business is an extraordinarily intensive enterprise, from the well head to the gas pump}

Rex Tillerson CEO, Exxon Mobil Corporation

Global energy demand (met primarily through oil, natural gas and coal) will increase by 60% from 2000 to 2030. The search for oil and gas is an activity that involves high risks, a high amount of investment and a long maturation period for the capital invested. The existing risk at the exploratory phase is related to the great number of variables involved on the search for hydro-carbons, such as: uncertainties of the geological features and high volatility of oil prices. For the Oil and Gas industry, techno managerial progress is an incremental process involving consistent investment and the application of scientific, engineering and managerial expertise over sustained periods of time and in the end, this process can have revolutionary results that can mitigate our energy needs.

## ELIGIBILITY

Minimum 60 percent marks at Higher and Senior Secondary level (10<sup>th</sup> and 12<sup>th</sup>). B.Tech in Chemical / Mechanical or MSc in Geology / Geo Physics / Physics with minimum 60% marks.

## ADMISSION CRITERIA

Screening of application and interview. Candidates with valid GATE score can also apply.



## FOCUS AREAS

- ④ Pipelines, Drilling and Completion
- ④ Health, Safety and Environment
- ④ Oil and Gas Resource Management
- ④ Production and Refining

# M.Tech Oil and Gas Engineering (OGE)

## COURSE STRUCTURE

	CODE	COURSE NAME	CREDITS*
<b>SEMESTER-I</b>	GE501	Petroleum Exploration and Prospecting	3
	GE502	Drilling and Production of Oil and Gas	3
	GE503	Petroleum Transportation Systems and Operations-I	3
	GE504	Basics of Petroleum Refining and Petro-chemicals	3
	GE505	Numerical Methods in Engineering	3
	GE506	Natural Gas : Properties and Handling	3
	GE507	Transport Phenomena	3
<b>SEMESTER-II</b>	GE601	Natural Gas processing Petroleum	3
	GE602	Transportation Systems and Operations-II	3
	GE603	Pumps and Compressor: Selection and Layout	3
	GE604	Natural Gas Reservoir Engineering	3
	GE605	Natural Gas from Non-conventional Sources	3
	GE606	Database Management System and Analysis	3
	GE607	Enterprise System Management and its Applications in Petroleum Sector	3
	GE608	Seminar on assigned topics	1
<b>SEMESTER-III</b>	GE701	Offshore Gas Production and Handling System	3
	GE702	Project, Material and Operations Management and Economics	3
	GE703	Process Modeling and Simulation	3
	GE704	Telemetry and SCADA System	3
	GE705	Developing LPG/CNG/LNG Chain Facilities	3
	GE706	Storage of Natural Gas	3
	GE707	Software Engineering	3
	GE708	Seminar on Internship	1
	GE709	Project-I	2
<b>SEMESTER-IV</b>	GE801	Health, Safety and Environment Management	3
	GE802	Petroleum Law, Policy and Contracts	2
	GE803	Project-II and Final Seminar	8
		Life Skills Management (Compulsory subject)	
<b>Total Credits</b>			<b>80</b>

\*1 Credit Hr = 12 Class Hrs / 24 Lab Hrs in a semester

"Delivery of an elective will be subject to availability of domain expert / faculty as well as minimum number of students for that particular elective"

# MS Program in Oil & Gas Engineering

*In collaboration with & academic accreditation by Gubkin Russian State University of Oil and Gas, Moscow, Russia*

*"The world's rapidly growing and varied energy needs in an immense global market is the essence of the challenge we face today. Energy business is an extraordinarily technology intensive enterprise, from the well head to the gas pump."*

**- Rex Tillerson  
CEO, Exxon Mobil Corporation**

Global energy demand (met primarily through oil, natural gas & coal) will increase by 60% from 2000 to 2030. Growing populations, especially in developing countries, will require more energy to attain higher standards of living, to address social pressures and to achieve greater security. The Indian Oil & Gas industry is estimated to be a US\$ 90 billion industry (16% of GNP), India is the 6th largest consumer of Petroleum products in the world and expected to be the 4th largest by year 2010. India is one of the most emerging Gas markets in the Asia-Pacific region. To realistically achieve and sustain this growth, techno managerial innovation in the Oil & Gas sector is a must. For the Oil & Gas industry, techno managerial progress is an incremental process involving consistent investment and the application of scientific, engineering and managerial expertise over sustained periods of time. And in the end, this evolutionary process can have revolutionary results that dramatically improve our energy future. Requirement of skilled professionals for the Oil & Gas sector in India itself from 2007 onwards is 2500+ Petro-Engineers and 1500+ Petro-Managers

## Program

I<sup>2</sup>IT in academic collaboration with RICCR, Moscow and Gubkin Russian State University of Oil and Gas offers MS Program in Oil and Gas Engineering (OGE). This is a 4-semester, 24-months, 72 credits, full time MS Program designed to equip students to accept challenges in the areas of core and related OGE.

- ▲ Upstream Petroleum Engineering
- ▲ Downstream Process Engineering
- ▲ Oil & Gas Resource Utilization & Asset Engineering
- ▲ Mathematical Modeling & Simulation, Computational Fluid Dynamics
- ▲ ERP applications
- ▲ Project Engineering Management
- ▲ Object Oriented Design and Development
- ▲ Seismic Data Processing & High Performance Parallel Computing

## About Gubkin University

Gubkin Russian State University of Oil and Gas, is Russia's principal higher educational institute of petroleum engineering and has been in existence for almost 75 years now. The University has developed a wide research capacity, which has led to the development of many new methods of exploration, production, transportation, refining and processing of hydrocarbons. It has since therefore a research center for oil and gas higher education of the Russian Federation.

## About I<sup>2</sup>IT, Moscow

To promote bilateral co-operation between India and Russia, I<sup>2</sup>IT, Pune has set up I<sup>2</sup>IT Moscow in the Russian-Indian Center for Advanced Computing Research (RICCR) campus. I<sup>2</sup>IT Moscow will offer advanced education and research in the fields of Information Technology and Management. RICCR will provide expertise in Computational Fluid Dynamics, Nano-Technology. Research programs for Masters and Doctoral degrees will be funded by Moscow State University.

The Institute aims to promote scientific research and development in hydrodynamics, weather forecasting, structural mechanics, advanced materials, nano technologies, bioinformatics, biotechnologies, artificial intelligence, environmental sciences and technologies. The Institute will organize seminars, conferences and conduct joint projects in Russia and India

## Program Structure

Successful completion of the program requires earning 72 Credits in 4 semesters and 24 months. The program is distributed over four semesters. First three semesters are the academic semester comprising of various courses including electives, laboratory, seminars and mini project. The fourth semester is for the final project, which is equivalent to 18 credits and is meant to bridge the gap between theory and

practice. The entire curriculum is distributed over six levels aimed at gradually increasing the student's understanding of domain subjects so that he or she is ready to be accepted by the corporate at the end of the program. The levels are Bridge, Foundation, Core, Advanced, Electives and Project in that order.

Students will be required to take one of the following three elective sets in the 3rd semester.

- ▲ Upstream Engineering
- ▲ Downstream Engineering
- ▲ Asset Engineering

## Program Pedagogy

All courses are designed to address the key issues like theoretical foundation, practical relevance and the real life problem solving approach. To achieve this, courses will be delivered using collaborative learning process through class room lectures, laboratory sessions, assignments, student seminars, directed reading, lectures by industry experts, case studies, relevant industry visits and research / industry project

## Distinctive Features

This is an International program in academic collaboration with Gubkin Russian State University of Oil & Gas, Moscow, Russia and one of its kind in Pan-Asia region. Students will undertake the 2nd semester of the 4 semesters at Gubkin University in Moscow, Russia

- ▲ Program offers electives in Upstream Petroleum Engineering, Downstream Process Engineering and Asset (Terotechnology) Engineering
- ▲ Extensive case studies & seminars delivered by experts from the industry & academics
- ▲ Hands on experience in high performance Parallel Computing and Software Design & Development
- ▲ Option to work on industrial projects offered by industries in the field
- ▲ Hands-on experience on simulators like Petrel, Aspen-Hysis, SAP, Fluent
- ▲ Provide across-the-board professional education and training to the graduates to keep them abreast of technical innovation and developments in this fast moving industry and the global competitive environment.
- ▲ Integrate technical knowledge and managerial skills with state-of-the art advanced IT tools to give a complete and innovative solutions to challenges in Oil & Gas sector
- ▲ Broaden the technical maturity of graduates to enable them to better communicate with different discipline areas and enable them to take on major responsibility and challenges early in their careers.
- ▲ Improve the employability of graduates and professionals from other sectors entering the oil and gas sector.
- ▲ Assist those with little oil and gas engineering experience to decide which part of the industry best suits their skills and interest.

## Eligibility

Graduates with recognized Bachelors Degree in Engineering/Technology (with minimum 60% marks or equivalent grade) in Mechanical / Chemical / Petrochemical / Petroleum / Production/ Industrial Engineering/ Civil / Environmental / Structural / Electrical / Electronics / EEE / ECE / Computer Science/ IT / Instrumentation & Control or MSC in Geology / Geosciences / Mathematics / Physics/Chemistry or MCA

## Program Commencement

The Program commences in July / October

## Selection Process

The selection of an applicant for the course is based on the following:

- ▲ Application forms shall be scrutinized for academic profile in line with the eligibility criteria.
- ▲ Scores received at the Graduation level like BE/ B Tech/ MCA/ M.Sc. etc
- ▲ Scores received at the "Accepted Qualifying Examinations" like GRE/ GATE
- ▲ Entrance Examination
- ▲ Performance in the Personal Interview

## Evaluation And Certification

- ▲ Continuous evaluation and performance improvement program
- ▲ Course-wise Credits
- ▲ Balanced assessment based on internals, laboratory, final theory examinations and project
- ▲ Detailed transcripts along with certificate

## Placement Assistance

- ▲ Career guidance at the institute
- ▲ Pre-placement facilitation / development and Campus Interview by leading Industries
- ▲ Active Interface with Oil & Gas and allied industries

## Bridge Courses

Keeping in view the diverse background of students getting enrolled, variety of courses are offered under bridge courses so that the students can attain the requisite level of competency for further learning. Students, depending on their background, will be advised to undertake specific bridge courses. Duration of the bridge courses is 3 weeks prior to the beginning of the academic term. Performance in the bridge courses count towards partial weightage in the relevant foundation courses.

## OGE001: APPLIED MATHEMATICS AND THERMODYNAMICS

This course will prepare the students in vector calculus, partial differential equations with boundary values, matrix method of solving differential equations using Eigen values, Eigen vectors and Jacobian matrix, numerical method for differentiation and integration, optimization techniques including queuing theory and dynamic programming. The first and second law of thermodynamics, PVT properties of gas and liquids, reversible

process for ideal gas, ideal gas phase equilibria and reaction equilibria, thermodynamic conditions for equilibrium, fugacity of vapor and liquids, VLE, LLE

## AST001: COMPUTER ARCHITECTURE AND OPERATING SYSTEMS

This course covers operating system design concepts with examples from Linux and windows operating system. It also focuses on the study of the hardware structure of computer systems and sub-systems. The topics in operating system include: Operating system structures Process and thread management, Memory management, Virtual memory, File system, I/O subsystem and device Communication, Introduction to Linux commands and shell scripts knowledge of a Linux text editor, Protection and Security management. The topics in computer architecture include: Processor architecture Parallelism and pipelining, Cache and memory organization, I/O controllers and interconnection structures

## AST002: DATABASE TECHNOLOGIES

This course focuses on the theory of database engineering. The course includes topics like file processing, introductory data structures, the differences between file processing and database processing, fundamental concepts of the relational model, normalization of data, database integrity issues, database design, SQL and an overview of the functions of a database management systems

## AST003: DATA STRUCTURES AND ALGORITHMS USING C

This course focuses on different data structures and their applications in computer programming. The data structures covered here are array, stack, queue, linked lists, binary tree and various sorting and searching algorithms. Literals, Scope, Namespaces, Primitive Data Types, Conditional and Iterative Constructs, Unconditional Transfer of Control, Basic Operator Syntax and Semantics, Basic I/O, Enumerated Types, Pointers, Arrays, Dynamic Memory Allocation, Run-time, Compile-time and Automatic Memory Allocation, Parameter Passing (simple types, pointers, arrays), Constants, Defining Types with typedef, Typcasting

**NTC002: COMPUTER NETWORKS**

This course shall emphasize on developing on understanding of the underlying principle of computer networking. Students will learn fundamental concepts of communication protocol stacks: OSI and TCP / IP, IP addressing schemes, subnetting, LAN, MAN, WAN fundamentals, circuit and packets switching, networking devices, network protocols, standards, Internet Intranet, network security and allied technologies

**Foundation Courses****OGE501: PETROLEUM FORMATION, DISCOVERY & DEVELOPMENT (3 Credits)**

This course will enable students to understand the fundamentals of geology and geophysics and their application in hydrocarbon exploration and includes petroleum formation, migration and entrapment; reading & interpretation of petrological diagrams; prediction of generation, movement and accumulation of hydrocarbons to identify potential drilling targets; properties of reservoir rocks; geophysical environment and important exploration methods; different petroleum drilling techniques including directional drilling; completion and evaluation methods; data requirements from a well and methods used to predict the volume of hydrocarbons in place.

**OGE502: TRANSPORT PROCESSES (2 Credits)**

In this unit the students will study fluid flow operation, mass transfer and heat transfer models. Governing equations for incompressible/compressible fluids will be delivered and studied for a range of applications, elementary viscous flow, including Couette flow, boundary layers and tube flows; transition Reynolds number and concepts of turbulence; skin friction, pressure drop calculations, handling cavitation, steady/ unsteady single phase and multiphase flows. The topics such as diffusion kinetics, conservation laws, theories of mass transfer, interphase mass transfer, important separation operations and mass transfer with phase change for heterogeneous reactions will also be studied. One-dimensional steady and unsteady heat conduction, fins, laminar and turbulent convection, condensation, heat exchangers, blackbody and gray body

radiation, boiling regimes and evaporation, industrial heat transfer operations and design. PDE's for the above transport processes in different coordinate systems will also be discussed.

**OGE503: PROGRAMMING IN FORTRAN & C++ (2 Credits)**

This course focuses on FORTRAN programming language for students who are going to write both application and system programs. Some prior knowledge of a high level language is a desirable. In addition to covering basic syntax and semantics, the course emphasizes on problem solving methodology and modular programming techniques. The focus is on imparting working knowledge of these programming languages; understand knowledge of common techniques such as linked lists, queues, etc. and basic mathematical techniques related to computing (error estimates, resource estimates, etc.)

This course also introduces C++ as a general-purpose computer language, leveraging the student's experience with C, java, or other computer languages. The focus is on understanding the purpose and intended application of language features. Topics include the application of abstraction and encapsulation using C++; interface design and implementation of independent object classes and user-defined types; the role of constructors, destructors, function, and operator overloading; I/O Streams facility and basic memory management programming techniques; the design and implementation of advanced container classes and class hierarchies.

**OGE504: INTRODUCTION TO ENTERPRISE RESOURCE PLANNING (2 Credits)**

The course would enable students to understand the concept of Enterprise Resource Planning or ERP; its functional modules and their inter-relationship. The managerial and technical issues in planning, designing, implementing, and extending enterprise systems and technologies will be an integral part of the course. Further, the course will include orientation to the use of software for modeling and mapping business processes.

**CFD502: MATHEMATICAL MODELING AND SIMULATION (2 Credits)**

This course will enable the students to develop mathematical models that

represent deterministic and probabilistic systems using the mathematical tools they have studied and will also include different types of process models and DOF analysis. Students will be learning finite difference method, Monte Carlo simulation, auto correlation, linear and nonlinear optimization, Markov process and are required to apply these concepts for solving fluid flow, mass transfer and heat transfer models. Examples of modeling in related areas will be discussed and major emphasis will be given to develop mathematical models to represent simple and complex engineering systems

**CFD504: COMPUTATIONAL MECHANICS & NUMERICAL MATHEMATICS (2 Credits)**

This course is designed to teach students the underlying concepts of numerical solution techniques and specific methodologies for solving fundamental problems via computer programs. The course objective is to teach students the basic techniques used to discretize continuous systems, as well as common methods to solve the resulting equations. The course is designed to familiarize the students with the cornerstones of modern computer-based analyses, such as matrix equation solution techniques, polynomial approximation, treatment of non linearity, dimensionless analysis, advanced techniques in finite difference and finite volume methods applicable to fluid flow problems. An important objective and central theme of this course is to develop programming skills that will be drawn upon in other parts of the curriculum

**CFD505: INTRODUCTION TO CFD (2 Credits)**

Here, students will be introduced to a range of computational techniques, stability analysis and modern acceleration techniques. In the second part of the course these ideas will be developed further with an introduction to incompressible flow solvers where artificial compressibility, pressure Poisson and pressure correction approaches will be introduced. This course emphasizes on classification of incompressible Navier-Stokes code with respect to various parameters, description of vorticity-stream function approach, SOLA code, SIMPLE / SIMPLER code, MAC code and Chorin code. Transformation of Navier-Stokes equation using generalized coordinate system and fundamental

concepts of grid generation and turbulence modeling will also be covered.

**RUS001: RUSSIAN LANGUAGE-I**

The course aims to consolidate knowledge of the Russian language and to extend the student's active and passive vocabulary, improve fluency, pronunciation, accuracy and comprehension skills. The course aims to increase the student's awareness of cultural information and social conventions in countries where the target language is spoken. This course is compulsory for all students

**OGE505: SEMINAR-I (1Credit)**

Students have to study the pre-assigned topic in depth, prepare seminar report and present the same to the designated panel

**Core Courses****OGE601: PETROLEUM FLUIDS AND PHASE RELATIONS (2 Credits)**

Here, students will study chemical composition of petroleum gas and oil. Carbon dioxide, hydrogen sulphide, hydrates and other compounds as sour elements and impurities. Physical, chemical and thermal properties of hydrocarbons and multi component systems including: phase equilibria, vapor-liquid equilibria and thermodynamic behavior. Equations of state modeling using HYSIS process simulator. Petroleum products and specifications: gas, Liquefied Natural Gas and Liquefied Petroleum Gas. Analysis and measurement of gas and liquid quantities. The purpose of this course is also to prepare students in multiphase relations as applied to condensate and retrograde condensate reservoirs.

**OGE602: RESERVOIR ENGINEERING (2 Credits)**

Basic reservoir rock and fluid engineering characteristics and analytical techniques to estimate hydrocarbon recovery. Methods to optimize reservoir development and recovery and data acquisition requirements to optimize and forecast future production

**OGE603: WELL ENGINEERING (2 Credits)**

Well completion, equipment and accessories design, evaluation and selection. Drilling, completion and production testing programs. Drilling fluid selection. Casing, tubing and packer force analysis. Perforation techniques and

equipment. Water and sand control. Special considerations for horizontal wells. Artificial lift design, evaluation and selection. Well stimulation and remediation techniques including hydraulic fracturing, propping and matrix acidising. Production logging and data acquisition. Well blow out.

**OGE604: NATURAL GAS ENGINEERING (2 Credits)**

In this course the students will get exposure to principles of development and operation of petroleum production systems, the combined behavior of the reservoirs, the surface equipment, the pipeline system, gas processing facility and the storage. Students will also get exposure on corrosion control, metering and regulation stations, process plant and automation systems required for natural gas storage facilities and optimization of these systems for various production schedules using queuing theory, linear and dynamic programming concepts.

**CFD506: PROGRAMMING ENVIRONMENT IN PARALLEL COMPUTING (2 Credits)**

The course lays stress on the use of parallel machines by applications of substantive size, covered application domains including scientific and engineering computation, real-time systems, graphics, and parallel optimization. Overview of parallel computing, concepts and terminology, parallel computing memory architecture, parallel programming models, design of parallel programs, Operating systems, MPI/ Open MPI calls, programming support for parallel computation, and specific example from fluid flow and heat transfer will be covered in this course. In addition to above, multicore, clusters and grid architecture will also be taught.

**AST602: OBJECT ORIENTED ANALYSIS & DESIGN USING UML (2 Credits)**

This course focuses on the major techniques of the Unified Modeling Language (UML), object-oriented analysis and design notation and how these techniques can be applied to improve quality of productivity during the analysis and design of application. The topics covered include object models, analyzing system requirements, modeling concepts provided by UML, analysis and documentation of software designs using the unified process, identification of use cases, behavioral designs, design patterns to refine analysis and design models, implementation,

testable and adaptable designs.

**RUS002: RUSSIAN LANGUAGE-II (1Credit)**

The level-II Russian language course will be delivered at Moscow and aims to improve fluency, pronunciation, accuracy and comprehension skills. The course aims to revise and extend high frequency language of personal relevance and to introduce students to informal and formal styles. This course is compulsory for all students.

**OGE605: SEMINAR-II (1Credit)**

Students have to study the pre-assigned topic in depth, prepare seminar report and present the same to the designated panel

**Advanced Courses****OGE701: INTEGRATED RESERVOIR CHARACTERIZATION & PERFORMANCES (2 Credits)**

This course will cover advanced topics in reservoir engineering, Advanced well testing analysis. Reservoir energy and performance estimates, Aquifer modeling. Immiscible displacement, recovery calculations and Improved oil recovery methods, reservoir heterogeneity, and types of heterogeneity models, effect of reservoir heterogeneity and flow processes upon oil recovery.

**OGE702: UNSTEADY FLOW EQUATIONS IN POROUS MEDIA & THEIR SOLUTION (2 Credits)**

This course focuses on the formulation and analytical solution of the transient fluid flow in porous media. This course will give knowledge on differencing schemes for the partial differential equations of single-phase flow with application to flow of gas and mixing in porous media.

**OGE703: NUMERICAL RESERVOIR SIMULATION (3 Credits)**

This course lays emphasis on mathematical analysis of complex reservoir behavior and combination drives; numerical methods for the solution of behavior equations; recent developments. This course will also emphasize on reservoir simulation: derivation of basic equations for 1D, 2D and 3D models. Definitions and types of simulators, principles, data input, grid selection, history matching, pseudo functions, well management, other simulators compositional, chemical,

thermal, dual porosity will also be addressed.

**OGE704: LNG & GTL TECHNOLOGY (1 Credit)**

This unit covers GTL chemistry; feed gas processing for LNG and GTL production; liquefaction thermodynamics and exergy analysis; liquefaction and regasification processes; LNG storage and transportation; LNG and GTL plant economics; material selection for GTL plant and LNG plant, LNG and GTL plant operations (instrumentation, control and safety systems); LNG and GTL markets and sales

**OGE705: PROJECT ENGINEERING MANAGEMENT (2 Credits)**

With the knowledge of exploration & production technology, students learn to amplify its effectiveness with applied project management techniques. This course covers the principles and application of project management to the upstream oil and gas activities and provides an overview of the theory and practice of managing any project in any organization. The fundamental building blocks of project management are addressed, including project planning, organizing, team building, and effective control mechanisms. Students gain a solid understanding and foundation to successfully manage each phase of the project cycle, work within organizational and cost constraints, set goals linked directly to stakeholder needs, and utilize proven project management tools to complete the project on time and within budget.

**CFD701: GEOMETRICAL MODELING & MESH GENERATION (2 Credits)**

This course will emphasize numerical simulations and computational grids, curvilinear grids, Winslow method, Godunov method, Structured and unstructured grids, spatial mappings and computational grids, Delaunay empty ball theorem and modern unstructured grid generation methods, construction of hybrid grid, basics of surface grid generation, surface flattening techniques, relations between curvature and manifolds parameterization, cone condition, isothermic, Chebyshev and quasi-isometric coordinates in MBC, adaptive meshing in numerical simulation, etc.

**ESD806: GRAPHICS AND VISUALIZATION (2 Credits)**

This course starts with introductory mathematics of computer graphics, and physics and electronics of computer graphics. These aspects are followed with attributes of output primitives, 2D geometric transformations, 2D viewing, and numerical methods in computer graphics. Course concludes with lighting and color models, rendering aspects and parametric and nonparametric descriptions of curves and surfaces for Geometric modeling. Also covers Embedded hardware accelerators and graphics co-processors for real-time rendering. Theory is supplemented with multiple lab experiments in C and C++.

**Elective Courses**

Three sets of electives are given below. A student is required to take up any one set of the three elective and study all the four courses within that set.

**UPSTREAM ENGINEERING**

**OGE811: SEISMIC MODELING & DATA PROCESSING (2 Credits)**

Here students will study theory and use of seismic ray trace modeling in survey design, testing or processing algorithms, and interpretation. Methods are developed in 1-, 2-, and 3-dimensions and focus is on asymptotic ray theory. Introduction to seismic data processing, the critical link between acquisition and interpretation, processing design for complex geologies. Extensive use of mathematical software for marine and land seismic data sets. Topics addressed also include the theoretical and applied analysis of the acquisition array models, temporal and spatial sampling, noise, wavelet non-stationary, amplitude normalization, FFT and IFFTs, filter theory, predictive, signature, and spike deconvolution, F-K filtering, velocity analysis and migration. Students will process from beginning to completion their own seismic lines.

**OGE812: ADVANCED FORMATION EVALUATION (2 Credits)**

Here the emphasis will be on application of petrophysical core analysis to formation evaluation. Integration of special core analysis with well logs. Focus will be on studying physical and textural properties of reservoir rocks, which provide a link

between reservoir engineering and well logging, advanced exploration and production logging, quantitative reservoir evaluation in different lithologies from log data, new logging techniques.

**OGE813: ADVANCED RESERVOIR SIMULATION (2 Credits)**

Advanced concepts of reservoir simulation for multidimensional, multiphase flow in hydrocarbon reservoirs will be studied. Topics in this course include modeling of complex wells, coupling surface facilities, compositional modeling, dual porosity modeling, treatment of full tensor permeability and grid non-orthogonality, local grid refinement, algebraic multigrid solvers, unstructured grid solvers, history matching, design of compositional reservoir simulators using a generalized Equation of State and other selected topics

**OGE814: ADVANCED PRODUCTION TECHNOLOGY: SYSTEM DESIGN & OPTIMIZATION (2 Credits)**

Emphasis will be on analyzing inflow well performances; two phase vertical flow, theory and design of artificial lift system. NODAL system analysis of production well and knowledge of optimum production facilities planning. Special topics like severe slugging and paraffin deposition will also be introduced.

**DOWNSTREAM ENGINEERING**

**OGE821: PETROLEUM REFINING PROCESSES (2 Credits)**

This course focuses on overview of petroleum products, crude oil characteristics, and refining process technology. The course contains information on the latest technologies and trends affecting the industry. For each refining process, the chemistry and process flow sheets are discussed. The integration of these processes to achieve different refining objectives is addressed, together with means of reducing operation costs by refinery optimization, integration of heat and energy systems.

**OGE822: CHEMICAL REACTOR DESIGN & CONTROL (2 Credits)**

This course covers topics in chemical reaction engineering, including multiple-reaction, non-ideal flow and residence-time distribution, 2D reactor models, and multiple-phase reactors, combined mass

transfer with chemical reaction. Timely applications of chemical reaction engineering are introduced and may include heterogeneous catalysis, polymerization, and biological reactions. The course also focuses on the dynamical behavior of systems, the design and operation of various types of controllers, including proportional, integral and differential and their combinations. The theoretical principles are demonstrated with applications to petroleum engineering processes.

**OGE823: PROCESS VESSELS: SELECTION, DESIGN & SIZING (2 Credits)**

This course introduces the concepts of clean processing and continues through to the selection, specification and engineering design of equipment; use of industry standards; Mechanical design of processing units: pressure vessels, heat exchangers, distillation columns etc.; valve selection and sizing; hierarchy of levels of design decision making; screening of process alternatives; preliminary process optimization; process retrofitting; use of computer software packages in the design; plant safety practices; applications of HAZOP and sustainability metrics.

**OGE824: PROCESS MODELING & SIMULATION OF SEPARATION PROCESSES (2 Credits)**

Here students will be required to apply the concepts of mathematical modeling and simulation studied in the earlier semester to conventional and advanced separation processes. Students will be required to use evolutionary methods for solving the complex model equations. Thermodynamic options for process design and use of industry standard computer packages for process simulation will also be a part of this course. Students will learn to develop the process from block diagrams, through to detailed material and energy balances and process flow diagrams; process flow sheeting; input-output structure of flow sheet; recycle structure of flow sheet; Flow sheet synthesis, integration and analysis will be carried out. Students will undertake quality assignments on steady state and dynamic simulation applications.

**ASSET ENGINEERING**

**OGE831: TEROTECHNOLOGY OF OIL & GAS RESOURCES & ASSETS (2 Credits)**

This unit applies the concepts of terotechnology to the full life cycle of oil and

gas assets and resources. Terotechnology is summed up as a combination of management, financial, engineering, and other practices applied to physical assets in pursuit of economic life-cycle costs (LCC). Focus will be on design specification, costs, commissioning, performance in terms of reliability and maintainability of upstream, flow lines & down stream assets including floating platform, their modification & replacement needs. Course also covers economic, physical, analytical, and statistical evaluation of hydrocarbon-producing assets, production forecasts and reserve estimation emphasizing relative worth of investments based on engineering judgment, time value of money; engineering analysis and prediction of cash flows of oil and gas resources.

**OGE832: ENVIRONMENT, HEALTH & SAFETY ISSUES IN OFFSHORE DEVELOPMENT (1 Credit)**

This module will cover aspects of decommissioning of offshore structures including: environmental impact; legal and legislative, health and safety issues. A major part of the course will focus on the existing environmental implications of the offshore oil and gas industry and environmental protection management. Including the effect of green house gases and CDM. This course will track the changes in offshore safety engineering perspective, approaches like early pipeline defect identification and remediation.

**OGE833: RISK ANALYSIS IN OIL & GAS OPERATION MANAGEMENT (2 Credits)**

This course will start with the need to carry out risk analysis of oil & gas project. Students will identify, characterize and quantify the risks associated with exploration and production operations. In this module, an overall process model relating to all the component processes will be constructed and an economic model will be generated capable of determining whether a project is economically viable. The deterministic module will be extended into the probabilistic model in order to incorporate subsurface risk and uncertainty analysis of oil and gas fields in decision-making. Students will be exposed to key concepts and applications of risk analysis as a profitable long-term business and risked valuations of petroleum assets. Emphasis will be to identify excessive risk exposure and develop ways to manage enterprise risk in the form of a case study.

**MBA711: ENTERPRISE RESOURCE PLANNING- II (3 Credits)**

This course will enable the students to have a hands-on exposure to configuring and running some of the basic and core functional processes. The objective here is to make them understand the importance of business process integration with respect to the three basic business systems, namely, Accounting, Materials Management and Sales. The students will do a set of exercises using SAP as the ERP platform. The focus will be on the procurement and the sales cycles

**Projects**

**OGE901: MINI PROJECT (2 Credits)**

Students are expected to undertake a mini project during the 3rd semester that includes an extensive literature survey and/or design and development of a system. An internal faculty guides the project. The project has to be submitted in the form of a report that will be examined by experts nominated by the institute

**OGE902: PROJECT (18 Credits)**

Students can take up an industry-sponsored project or a research based in-house project leading to Master's level competency.

For industry-sponsored projects, the Career Management Center of the Institute facilitates interaction between students and the industry. Students are encouraged to work on projects that will enhance their understanding in certain oil and gas technology domains in real-life scenario.

The research project includes researching on the given/chosen seminar topic that will generally be state-of-the-art in the field and then delivering the seminar to peers and faculty along with its documentation in the prescribed format. Following the seminar the student has to undertake a research project under the guidance of tenure track/visiting faculty / and industry experts. The research project has to be submitted in the form of a dissertation that will be examined by experts nominated by the institute. The research project is the culmination of the student's learning in the institute and is expected to be of high standards as demanded by the industry from time to time.

**Total Course Credits: 72**

# MS Program in Oil & Gas Engineering

## Course Structure

	Code	Course Name	Credits*
<b>BRIDGE</b>	OGE001	Applied Mathematics & Thermodynamics	
	AST001	Computer Architecture & Operating Systems	
	AST002	Database Technologies	
	AST003	Data Structures & Algorithms using C	
	NTC002	Computer Networks	
<b>FOUNDATION</b>	OGE501	Petroleum Formation, Discovery & Development	3
	OGE502	Transport Processes	2
	OGE503	Programming in FORTRAN & C++	2
	OGE504	Introduction to Enterprise Resource Planning	2
	CFD502	Mathematical Modeling & Simulation	2
	CFD504	Computational Mechanics & Numerical Mathematics	2
	CFD505	Introduction to CFD	2
	RUS001	Russian Language-I	
	OGE505	Seminar-I	1
<b>CORE</b>	OGE601	Petroleum Fluids & Phase Relations	2
	OGE602	Reservoir Engineering	2
	OGE603	Well Engineering	2
	OGE604	Natural Gas Engineering	2
	CFD506	Programming Environment in Parallel Computing	2
	AST602	Object Oriented Analysis & Design using UML	2
	RUS002	Russian Language-II	1
	OGE605	Seminar-II	1
	<b>ADVANCED</b>	OGE701	Integrated Reservoir Characterization & Performances
OGE702		Unsteady Flow Equations in Porous Media & their solution	2
OGE703		Numerical Reservoir Simulation	3
OGE704		LNG & GTL Technology	1
OGE705		Project Engineering Management	2
CFD701		Geometrical Modeling & Mesh Generation	2
ESD806		Graphics and Visualization	2
<b>ELECTIVES</b>		<b>Upstream Engineering</b>	
	OGE811	Seismic Modeling & Data Processing	2
	OGE812	Advanced Formation Evaluation	2
	OGE813	Advanced Reservoir Simulation	2
	OGE814	Adv. Production Technology: System Design & Optimization	2
	<b>Downstream Engineering</b>		
	OGE821	Petroleum Refining Processes	2
	OGE822	Chemical Reactor Design & Control	2
	OGE823	Process Vessels: Selection, Design & Sizing	2
	OGE824	Process Modeling & Simulation of Separation Processes	2
	<b>Asset Engineering</b>		
	OGE831	Terotechnology of Oil & Gas Resources & Assets	2
	OGE832	Environment, Health & Safety issues in offshore development	1
	OGE833	Risk Analysis in Oil & Gas Project Management	2
	MBA711	Enterprise Resource Planning- II	3
<b>PROJECT</b>	OGE901	Mini Project	2
	OGE902	Project	18

\* 1 Credit = 16 Class Hrs / 32 Lab Hrs in a semester

## MS by Research

Research can be broadly defined as the systematic investigation into and study of, materials or sources in order to establish facts and reach new conclusions. As such research drives the creation of knowledge capital thereby greatly increasing our understanding of the natural world. The restless human spirit of curiosity steadily endows science with new information in turn enabling us to achieve greater feats. The horizons of scientific endeavor are forever redrawn by the relentless pursuit of researchers in their quest to broaden society's knowledge base.

In today's world, research is no longer restricted to theoretical pursuits but is frantically driven by commercial / industrial application. Research and Development (R&D) has become an important sector of the modern world. Corporations host in-house R&D Centers in their bid to stay one step ahead in the fast-paced marketplace. Applied research is being conducted in every area across verticals, be it emerging technologies or traditional methods. Multi-national giants are quickly brought down to their knees if they fail to recognize the power of R&D when the competition launches the 'next big thing' and market-share plummets. Multinational organizations are also concentrating on migrating high-tech R&D by exploring Research Process Outsourcing. High tech firms are launching R&D programs that deal with products meant for the global market. According to an Economists' Intelligence Unit's Global Survey, India is a large recipient of global R&D expenditures going forward. Experts state that this is because companies expect some of the fastest growth in future to come from Asian giants like India and China. Indian Universities are, therefore investing in R&D facilities and improving their research atmosphere. They are also looking at tapping global research opportunities for foreign organizations and Universities.

### Program

The value of research is proportionate to the quality of the researcher's methodology. A good foundation in research methodology begins at the Masters level. The MS by Research is particularly appropriate for students with a general preparation in the subject and who wish to focus their interests and deepen their knowledge of a given topic. MS by Research is suited to candidates who have the internal drive to explore advanced areas in their chosen field and have the capacity to independently arrive at logical conclusions. Candidates acquire valuable skills which can be further utilized for advanced education or directly employed for industry / applied R&D.

### Program Details

- ▶ This is a 72 credit course in which the student has to undergo eight courses (3 fundamental, 3 core and 2 advanced) along with 3 credit subject entitled 'Research Methodology'.
- ▶ These seven courses are taken from the regular MS in AIT programs within the stream or from other relevant stream in consultation with guide and should have endorsement of advisory committee.
- ▶ Student must complete these course works within four trimesters from the date of registration.
- ▶ Internal Candidate (full-time employee) can take maximum three subjects per trimester to ensure fulfilment of any other

institute commitments.

- ▶ External Candidate (deferred Student of IIT) should take the remaining courses to fulfill the requisite course requirement for MS by Research.
- ▶ Under guide's recommendation, student has to take three self-study courses. Student at the end of the course has to present the same in front of panel of judges (minimum 2 members). These courses are of 3 credit each.

### Program Pedagogy

- ▶ The student has to select the courses in consultation with guide as indicated. Internal or full-time students should take any courses offered by the institute under the regular on-campus programs.
- ▶ For the working student, if the situation demands, the institute can offer these courses on-campus on weekends or in the evening or through distance education program.
- ▶ The institute reserves the right to decide the mode of delivery of the course and the pedagogy.

### Program Structure

#### Pre-registration Seminar

- ▶ Student has to give the pre-registration seminar within six months from the date of joining the program indicating the title of the thesis, area of research work and proposed framework for research.

- ▶ The advisory committee constituted by the institute should examine and approve the same.
- ▶ Once it is approved, student can initiate the research work in the proposed area.

#### Research

- ▶ On approval of the pre-registration seminar, student can start the research work in the specified area.
- ▶ Student has to carry out extensive research work in the said area.
- ▶ The measure of extensiveness should lead to minimum two publications in Indian / International Conferences or minimum one publication in the referred National / International journal.

#### Synopsis Seminar

- ▶ On near completion of the research work, the student has to give a synopsis seminar to present the exact research work done so far.
- ▶ The advisory committee constituted by the Institute should examine and approve the same as acceptable standard for the program.
- ▶ If committee feels otherwise, the student has to carry out the research work further as per committee's suggestion.
- ▶ On approval from the guide, student can give synopsis seminar once again.
- ▶ The student has to clear this phase by availing at most three synopsis