

PE	Petroleum Engineering
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Section 1:	Engineering Mathematics
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Linear Algebra: Matrix algebra; Systems of linear equations; Eigenvalues and eigenvectors.

Calculus: Functions of single variable; Limit, continuity and differentiability; Taylor series; Mean value theorems; Evaluation of definite and improper integrals; Partial derivative, Total derivative; Maxima and minima; Gradient, divergence and curl; Vector identities; Directional derivatives; Line, surface and volume integrals; Stokes, Gauss and Green's theorems.

Differential Equations: First order equations: linear and nonlinear; Higher order linear differential equations with constant coefficients; Cauchy's and Euler's equations; Initial and boundary value problems; Laplace transform; Solution of one-dimensional diffusivity equation and Laplace equation.

Complex Variables: Complex number; Polar form of complex number; Triangle inequality.

Probability and Statistics: Definitions of probability and sampling theorems; Conditional probability; Mean, median, mode and standard deviation; Random variables; Poisson, normal and binomial distributions; Linear regression analysis.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; Integration by trapezoidal and Simpson's rule; Single and multi-step methods for numerical solution of differential equations.

Section 2:	Petroleum Exploration
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Classification and description of some common rocks with special reference to clastic and non-clastic reservoir rocks; Origin, migration and accumulation of petroleum; Petroleum exploration methods; Petroleum resource classification and evaluation.

Section 3:	Oil and Gas Well Drilling Technology
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Well planning; Drilling methods; Drilling rigs; Rig operating systems; Drilling fluids, function and properties; Drilling fluid maintenance equipment; Oil and gas well cementing operations; Drill bit types and their applications; Drill string and casing string function, operation, selection and design; Drilling problems, their control and remedies; Directional drilling tools; Directional survey; Application of horizontal, multilateral, extended reach; Slim wells; Intelligent drilling and completion techniques: image assisted drilling, managed pressure drilling, underbalanced drilling.

Section 4:	Reservoir Engineering
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Petrophysical properties of reservoir rocks; Coring and core analysis; Reservoir fluid properties; Phase behaviour of a hydrocarbon system; Single phase and multiphase flow through porous media; Water and gas coning; Reservoir pressure measurement; Reservoir drives, drive mechanisms and recovery factors; Theory of material balance; Reserve estimation and techniques; Field development and reservoir management; Reservoir geomechanics: Stress analysis and fracturing; Basics of reservoir simulation: mathematical models, finite difference discretization, Cartesian and radial grid systems, black oil reservoir simulation, history matching.

Section 5:	Petroleum Production Operations
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Well equipment; Well completion techniques; Well production problems and mitigation; Well servicing and Workover operations; Workover and completion fluids; Formation damage; Well stimulation techniques; Artificial lift techniques; Field processing of oil and gas; Storage and transportation of petroleum and petroleum products; Metering and measurements of oil and gas; Production system analysis and optimization including inflow performance, tubing performance, and nodal analysis; Production testing; Multiphase flow in tubing and flow-

lines; Flow assurance: Problems and remedies; Pressure vessels, storage tanks, shell and tube heat exchangers, pumps and compressors.

Section 6: Offshore Drilling and Production Practices

Offshore oil and gas operations and ocean environment; Buoyancy and stability; Offshore fixed platforms, Offshore mobile units, station keeping methods like mooring and dynamic positioning system; Offshore drilling from fixed platform, jack-up, ships and semi submersibles; Use of conductors, risers and umbilicals; Offshore well completion; Deep water applications of subsea technology; Offshore production: Oil processing platforms, water injection platforms, storage, Single Point Mooring (SPM) and Single Buoy Mooring (SBM), transportation and utilities; Deep water drilling and production system.

Section 7: Petroleum Formation Evaluation

Petrophysical evaluation of sub-surface formations: principles, applications, advantages and disadvantages of Spontaneous Potential (SP), resistivity, radioactive, acoustic logs, gamma ray logs and types of tools used; Logging While Drilling (LWD); Evaluation of Cement Bond Log (CBL)/ Variable Density Log (VDL), Ultrasonic Imager Tool (USIT), Segmented Frequency Tool (SFT), Repeat Formation Tester (RFT); Production logging tools, principles, limitations and applications; Special types of logging tools; Casing inspection tools: principles, applications and limitations; Formations micro scanner (FMS), Nuclear Magnetic Resonance (NMR) logging principles; Standard log interpretation methods; Cross-plotting methods.

Section 8: Oil and Gas Well Testing

Diffusivity equation and its solutions; Radius of investigation; Principle of superposition; Horner's approximation; Drill stem testing; Pressure transient tests: drawdown and build up-test analysis; Pressure derivative analysis; Wellbore effects; Multilayer reservoirs; Injection well testing; Multiple well testing; Interference testing; Pulse testing; Well-test analysis by use of type curves; Gas well testing; Inflow testing.

Section 9: Health Safety and Environment in Petroleum Industry

Health hazards in Petroleum Industry: toxicity, physiological, asphyxiation, respiratory and skin effect of petroleum hydrocarbons, sour gases; Safety System: manual and automatic shutdown system, blow down systems; Gas detection system; Fire detection and suppression systems; Personal protection system and measures; Health, Safety and Environment (HSE) policies; Disaster and crisis management in petroleum industry; Environment: Environment concepts, impact on ecosystem, air, water and soil; The impact of drilling and production operations on environment; Environmental transport of petroleum wastes; Offshore environmental studies; Offshore oil-spill and oil-spill control; Environmental regulations and compliance.

Section 10: Enhanced Oil Recovery Techniques

Basic principles and mechanism of Enhanced Oil Recovery (EOR); Screening of EOR processes; Concept of pattern flooding, recovery efficiency, permeability heterogeneity; Macroscopic and microscopic displacement efficiency; EOR methods: chemical flooding, miscible flooding, thermal recoveries (steam stimulation, hot water and steam flooding, in-situ combustion), microbial EOR, low salinity water flooding.

Section 11: Latest Trends in Petroleum Engineering

Coal bed methane, shale gas, oil shale, gas hydrate, heavy oil, physical and chemical trapping of CO₂ in underground reservoirs.