Fourth Semester

Course Title: Geo-Physics

Course Code: PTE 401

Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 2 lectures, 1 tutorial and 1 practical.

Objective: Understand and apply geological and geophysical methods for the evaluation of subsurface formations.

SN	Topic	No. of Lectures
PTE 401	Geo-Physics **Unit-1: Introduction to Geophysical Methods-Bridging the Knoledge gap-Basics of M/P/G** Properties of Matter and Energy, formulae, Measurable physical quantities, definitions, units, formulae, applications, Basic concepts of Physics, Mathematics, Geology and their relationship, Properties and applications of different types of rocks and minerals, structures, tectonics Principles Exploration Geophysics, Meaning of Geophysical anomalies. **Unit-2: Gravity Method:** Understanding the phenomena of Gravity and acceleration due to Gravity, Principle of Gravity method, variation, anomaly, Principle of Gravity meter, measurement of 'g', Gravity survey planning, Gravity data acquisition, Gravity data processing ,Gravity data interpretation **Unit-3: Magnetic Method** Rock magnetism, Geomagnetism, variations, Principle of magnetic method, magnetic anomaly, Principle of Magnetometers, Magnetic survey planning, data acquisition, Magnetic data processing, Magnetic data interpretation	48

	Unit-4: Magnetotelluric Method: Telluric currents, sources, magnetic and electric fields ,Principle of MT method, equipment, Acquisition of MT data, layouts, processing Interpretation of MT data, section preparation **Unit-5: Seismic Methods-Fundamental** Seismology, classification, application, Elastic properties, seismic waves, properties, Types of seismic waves, propagation, Fermat's and Huygens Principles, Laws of reflection- verification, Law of refraction- verification, Acoustic impedance, reflection-refraction coefficients, partition of Seismic energy, Reflection meaning, solid-fluid phases **Unit-6: Seismic Infrastructure-Procedures:** Seismic Energy sources, classification, properties, Receivers-types, working principles and ranges, Arrays, spreads, Layouts **Unit-7: Seismic Surveys- Data Acquisition:** seismic surveys, 2D, 3D,4D, 3C, 4C, 9C, MC, On-shore and Off-shore surveys, Acquisition parameters, Data recording, formats, multiplexing, 2D seismic data acquisition design **Unit-8: Seismic Data Interpretation:** Three major steps in seismic data interpretation, Seismic sequence stratigraphy interpretation, Structure and tectonic interpretation Lithological interpretation, Seismic Work-station, issues, Pit-falls in seismic data interpretation	

Outcome:

- Students develop a sound knowledge on Seismology, Seismic survey techniques for oil and gas exploration.
- Student would be able to understand: Main geophysical methods; Wave propagation – P and S waves, alteration at interfaces (reflection/refraction); Seismic method (data gathering and interpretation); Use and limits of seismic in reservoir description.

Books:

- Allen P A and J R Allen, 2005, Basin Analysis: Principles and Applications, Second edition, Wiley Blackwell
- Enwenode Onajite, 2014, Seismic Data Analysis Techniques in Hydrocarbon Exploration, Elsevier, 232 pp
- Guidelines for Application of the Petroleum Resources Management System, 2011, Joint publication of SPE, AAPG, WPC, SPEE and SEG
- Luca Cossentino, 2001, Integrated Reservoir Studies, Technip, 328 pp.

- McQuillin R., Bacon M., and Barclay W., “An Introduction to Seismic Interpretation”, Gulf Publishing, 1948.
- Petroleum Society of Canada, 1994, Determination of Oil and Gas Reserves, 394 pp.
- Rao Ramchandra M. B.,1987, “Outline of Geophysical Prospecting”, EBD Publishing,

Course Title: Numerical methods for Petroleum Engineers

Course Code: PTE 402

Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: No

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, 1 tutorial.

Objective: The course will provide applied knowledge of different numerical methods and simulation techniques employed in petroleum industries.

SN	Topic	No. of Lectures
PTE 402	Numerical methods for Petroleum Engineers Unit I Root finding - General iteration methods, Newton Raphson method, bisection method, Solution of system of linear equation by Gauss elimination method and Gauss Siedel method, Curve fitting. Unit II Interpolation- Newton's forward Interpolation formula, Newton's backward Interpolation formula, Newton's Interpolation formula for unequal interval, Lagrange's Interpolation formula for unequal interval. Unit III Numerical Differentiation- Newton's divided difference formula; Numerical integration-Trapezoidal rule, Simpson's rule, Weedle's rule. Numerical Solution of differential equation-Solution with Taylor's series, Euler's method, modified Euler method, Runge-Kutta method, Boundary value problems. Unit IV Graphical and analytical methods of optimization, Numerical search methods, linear programming, and Evolutionary methods of optimization.	48

Outcome:

- To know about various types of Errors, Calculate the error correction and get actual root of the equation, Understand different methods of solution of the equations and compare them.
- Students will be made aware of different numerical and statistical methods which are used in engineering field, with emphasis on how to prepare program for different methods.

BOOKS:

- Sastry, S.S., "Introductory Methods of Numerical Analysis", Prentice Hall of India Pvt. Ltd., 2004.
- Edgar, Himmelblau and Lasdon, "Optimization of Chemical Processes", 2nd Ed.
- S. K. Gupta,Numerical Methods for Engineers. Wiley Eastern, New Delhi, 1995.

Course Title: Mass Transfer

Course Code: PTE 403

Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: - No

Time of examination: 2 hours and 30 mins

Objective: The course will provide information on different Mass Transfer Techniques employed in petroleum industries and recent advancement in the technology.it will facilitate to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes.

SN	Topic	No. of Lectures
PTE 403	Unit I **Diffusion and Interface Mass Transfer:** Molecular diffusion, steady state molecular diffusion in fluids at rest, molecular diffusion in gases-steady state diffusion: of A through non diffusing B, equimolal counter diffusion. Effect of temperature and pressure on diffusivity. Mass transfer coefficients, film theory, penetration theory, surface-renewal theories. Mass, Heat, and momentum-transfer analogies, interphase mass transfer: equilibrium, diffusion between phases, local two-phase mass transfer, local overall mass-transfer coefficients. Unit II **Distillation:** Distillation-Stage wise contact operation. Methods of distillation: batch, continuous, flash, steam, vacuum, molecular distillations. McCabe-Thiele and Ponchon-Savarit methods. Design of distillation towers. Azeotropic and extractive distillation. Elements of multi component distillation. Unit III **Absorption :** Introduction, types of tower packing's, contact between liquid	**48**

	and gas, pressure drop and limiting flow rates, material balances, limiting gas-liquid ratio, rate of absorption, calculation of tower height, number of transfer units, alternate forms of transfer coefficients, absorption in plate columns. Unit IV **Humidification and Drying :** Definitions, adiabatic saturator, Humidity chart, use of humidity chart, wet-bulb temperature, theory of wet-bulb temperature, psychometric line and Lewis relation, equations for gas-liquid contacts, air-water system, adiabatic humidification, application of HTU method. Overview of Extraction and adsorption. Introduction to drying.	

Outcome: On completion of this course, the students would learn to design absorber and stripper, Distillation column, extraction and leaching equipment's and adsorber

BOOKS:

- R.E. Treybal, Mass Transfer Operations, McGraw-Hill Book, 3rd Edition 1980.
- B. K. Dutta, Principles of Mass Transfer and Separation Processes, PHI, 2007.
- Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.
- Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
- Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc.New Jersey, 2003.
- Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley, 2006.
- McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn. McGraw-Hill, 2005.
- King, C. J., "Separation Processes ", 2nd Edn. Tata McGraw-Hill 1980.

Course Title: Drilling Engineering & Well Completion
Course Code: PTE 404
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: - No
Time of examination: 2 hours and 30 mins
Objective: To learn design aspects of drilling equipment, techniques, operational procedures for vertical, directional drilling and construction of well bore.

SN	Topic	No. of Lectures
PTE 404	**Drilling Engineering & Well Completion** Unit I Drilling and Cable Tool Drilling, Rotary Drilling Rig Components Wire Rope: Construction, Service Life, Handling Drill String, Casing Pipe, Production Tubing: Characteristics and Design Considerations Unit II Drilling Bit: Type, Feature and Coring Bit Drilling Fluid: Properties, Additives Circulation System: Pump Characteristics. Pressure Loss Calculation Drilling Practices: Straight Hole. Directional. Horizontal.; Tools and Techniques Coring: Core Barrel. Core Recovery and Handling Unit III Well Casing. Tools and Procedures Measurements While Drilling: Tools, Data Acquisition and Interpretation Drilling Complications: Blow Out; Blow out Preventers, Pipe Sticking, Causes and Remedy, Fishing Tools and Operations. Cement and Cementing: Oil Well Cement Types, Slurry Design. Primary, Stage and Squeeze Cementing Unit IV Drill stem testing Well head assembly. Testing Casing Perforation: Tools and Practices. Well Activation. Well Control System: Christmas Tree and Valves Environmental Impact. Oil Mine Safety Regulations Drilling Economics	**48**

Outcome:

- Understand basic components of drilling engineering for well planning and design
- Design the well using different parameters
- Understand well control methods and signatures of well in stability
- Know and apply codes for well design
- Understand rig hydraulics
- Apply rheological concepts for cement jobs

Books:

- Adams N.1985; Drilling Engineering: A Well Planning Approach, Penwell Publishing Company. 489 pp.
- Bourgoyne A. T, Jr. Adam T. Millheim, Martin E. Chenevert, Jr. F. S. Young.1986; Applied Drilling Engineering, SPE Text Book Series.508 pp.
- Grace, Robert D, Cudd, Garden Shurjen, 1994; Advanced Blowout and Well Control, Gulf Publishing Company. 414 pp.
- Rabia H.1995; Well Engineering and Construction. 640 pp.

Course Title: Petroleum Formation Evaluation & Well Logging
Course Code: PTE 405
Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: - No

Time of examination: 2 hours and 30 mins

Objective: To understand purpose, principles and applications of different logging tools and apply quick look methods of log interpretation to obtain properties of rocks and fluids.

SN	Topic	No. of Lectures
PTE 405	Unit I: The Basis of well logging, Major components of logging units, Bore hole environments, Petro physical and reservoir parameters, Formation factor, Water saturation; Unit II: Open-hole logging: Self potential log-computation of formation water resistivity; Resistivity logs Focused and non-focused logs; Radioactive logs - Gamma ray, Neutron and density logs Caliper and Dip meter logs, Unit III: Principles and porosity determination; porosity logs, sonic logs, responses of resistivity and porosity logs, Pressure measurement; Cased-hole logging: Cement bond tool and its application, Qualitative and quantitative interpretations for lithology, minerals and reservoir properties. Unit IV: Use of well logs in stratigraphic correlation. New developments in well logging techniques and tools; Computer applications in log interpretation.	**48**

Outcomes:
After completing this course the student will be able to

- Apply different logging methods for the evaluation of subsurface formations
- Apply principles of mud logging in the recognition of oil and gas show
- Apply principles of physics in the recognition and calculation of different parameters of formations
- Apply quick look interpretation methods in the evaluation of hydrocarbon recognition
- Interpret broad depositional environment from log signatures

- Develop awareness of recent developments in the evaluation of formations.

Books

- Asquith George & Krygowski Daniel, 2004, Basic Well Log Analysis. USA. AAPG,
- Stefan M. Luthi, 2001, Geological Well Logs: Their Use in Reservoir Modelling, Springer, 381 pp.
- Log Interpretation, Vol. I to IV and Document VIII; Schlumberger, 1979.

GEOLOGY LABORATORY

Objective:

To demonstrate various methods involved in the preparation of structural maps and interpretation and calculation the thickness of the beds, studying depositional environment using grain size analysis and find out sediment types using Sand – Silt – Clay ratio.

List of Experiments:

- Calculation of True and Apparent Dip.
- Estimation of Thickness, Distance and Depth of the ore body.
- Estimation of Throw and Nature of the fault.
- Interpretation of surface Geology using contour maps.
- Sand – Silt – Clay ratio estimation.
- Grain – Size analysis.
- Identification of important sedimentary rocks in hand specimen.
- Identification of important sedimentary rocks in microscopic level

Outcome:

Students will be able to understand the preparation of Geological maps and identify the rock specimens by Megascopic and Microscopic, Identify the Depositional environment and Sediment types.

List of Equipment's:

- Sieve Shakers
- Sieves set.
- Petrological Microscopes
- 1000 ml and 50 ml beakers

DRILLING FLUIDS LABORATORY

Objectives:

To demonstrate the processes involved in drilling operations, introduce laboratory techniques which are used to select and optimize drilling fluids and to develop interest in experimentation.

List of experiments:

- To prepare the mud sample with given bentonite and fresh water.
- To determine the Marsh Funnel Viscosity of given mud sample.
- To determine the pH of a given mud sample
- To determine the gel strength of a mud sample.
- To determine the sand content of drilling fluid.
- To determine the Filtration Loss & Cake Thickness of given mud sample.
- To determine the Mud Density of given mud.
- To determine the Apparent Viscosity, Plastic Viscosity, Yield Point & True Yield Point of given mud

Outcome:

Students able to understand the drilling fluid equipment, Principles and operation and oil well properties.

List of Equipment's:

- Mud Mixer
- Marsh funnel
- Filter press, low pressure – Low temperature and high temperature filters
- PH meter
- Sand content kit
- Hydrometer
- Mud resistivity meter
- 1000 ml and 50 ml beakers
- Weight Machine.

GEOPHYSICS LABORATORY

Objectives:

To demonstrate the processes involved in geophysical operations, introduce laboratory techniques which are used to select and optimize geological interpretation and to develop interest in experimentation.

List of experiments:

- Study of simple seismic section
- Study of resistivity meter, gravimeter, and magnetometer.
- Preparation of different subsurface maps
- Geological data analysis.
- Exercises based on subsurface geological and geophysical data.
- Determination of total porosity and interconnected porosity and permeability.

Outcome:

- Students able to understand the geophysical equipment, Principles and operation and rock properties by analyzing geological data's.

List of Equipment's:

- Different Seismic section
- Geological data (gravity, magnetic data etc.)