JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.TECH. PETROLEUM ENGINEERING
III YEAR COURSE STRUCTURE & SYLLABUS (R16)

Applicable From 2016-17 Admitted Batch

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	PE501PC	Instrumentation and Process Control	4	1	0	4
2	PE502PC	Well Logging and Formation Evaluation	4	0	0	4
3	PE503PC	Thermodynamics for Petroleum Engineers	4	1	0	4
4		Open Elective - I	3	0	0	3
5	SM504MS	Fundamentals of Management	3	0	0	3
6	PE505PC	Instrumentation and Process Control Lab	0	0	3	2
7	PE506PC	Well Logging and Formation Evaluation Lab	0	0	3	2
8	PE507PC	Energy and Environmental Engineering Lab	0	0	3	2
9	*MC500HS	Professional Ethics	3	0	0	0
		Total Credits	**21**	**2**	**9**	**24**

III YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective - II	3	0	0	3
2		Professional Elective - I	3	0	0	3
3	PE601PC	Drilling Technology	4	0	0	4
4	PE602PC	Petroleum Reservoir Engineering	4	0	0	4
5	PE603PC	Petroleum Refinery Engineering	4	0	0	4
6	PE604PC	Drilling Fluids Lab	0	0	3	2
7	PE605PC	Petroleum Reservoir Engineering Lab	0	0	3	2
8	EN606HS	Advanced English Communication Skills Lab	0	0	3	2
		Total Credits	**18**	**0**	**9**	**24**

During Summer Vacation between III and IV Years: Industry Oriented Mini Project

Professional Elective - I

PE611PE	Pipeline Engineering
PE612PE	Natural Gas Processing
PE613PE	Petrochemical Engineering

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

INSTRUMENTATION AND PROCESS CONTROL

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: PE501PC	**4 1/0/0 4**

Prerequisites: Chemical Engineering Fluid Mechanics and Process Heat Transfer

Course Objectives: The subject is designed to understand the fundamentals and principles of Process Control and instrumentation It also provides the details of performance characteristics and applications of various instruments used in petroleum industry.

Course Outcomes: The student would be able to understand Process modeling fundamentals, idealized dynamic behavior, transfer functions, control system context like evaluate stability, frequency response, and other characteristics relevant to process control.

UNIT - I

Elements of instruments, static and dynamic characteristics, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy. Thermo electricity: Industrial thermocouples, thermocouple wires, thermo couple wells

Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement by spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer

UNIT - II

Measurement of Pressure and vacuum: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids

Measurement of head and level: Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels..

velocity meters, quantity meters, viscosity measurements. Recording instruments, indicating and signalling instruments, transmission of instrument readings, control center, instrumentation diagram

UNIT - III

Introduction to process control: Response of First order systems, Transfer Function of mercury thermometer, Transient response to step, impulse, sinusoidal forcing function, physical examples of first order systems, liquid level, mixing process, RC circuit, response of first order systems in series: Noninteracting and interacting systems

UNIT - IV

Response of Second order system to step, impulse and sinusoidal forcing function. Transportation lag .

The control system: Servo and Regulatory control problems, Development of Block diagram, Controllers and final control elements, Ideal transfer functions of P, PI, PD and PID Controllers. closed loop transfer functions, Stability: Stability analysis by Routh's Criterion

UNIT - V

Root locus: concept of root locus, plotting the root locus diagram.

Introduction to frequency response: substitution rule, Bode diagrams for First order, first order systems in series, second order system and for controllers and transportation lag. Bode stability criterion. Gain margin and phase margin, Z-N controller settings

TEXT BOOKS:

1. Industrial instrumentation by Donald P. Eckman, Wiley eastern, 1950.
2. Donald R. Coughanowr, Process Systems Analysis and Control, 2nd edition McGraw-Hill,1991

REFERENCE BOOKS:

1. Principles of industrial instrumentation by Patra Nabis, TMH.
2. Chemical Process Control Stephanoupoulous, G., Prentice Hall, India New Delhi. 1990.

WELL LOGGING AND FORMATION EVALUATION

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **PE502PC**	**4 0/0/0 4**

Prerequisites: General Geology and Petroleum Geology

Course Objectives:

- To know the logging terminology.
- To delineate hydrocarbons through direct and indirect means/methods.
- Determination of formation lithology through logs like S.P, G.R etc. and also depositional environment with the help of Gamma rays spectroscopy and Dip-meter tools.
- Determination of physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.
- Hydrocarbon saturation estimation with the data acquired by the logging tools.
- Hydrocarbons reserves estimation in a particular block.
- Refinement of the log interpretation data with the help of advanced technology tools namely, Scanner, NMR, Modular formation tester etc.

Course Outcomes: From the well logs:

- Will be able to identify the lithology, depositional environment of subsurface strata.
- Will be able to calculate the porosity, permeability, thickness of different interesting layers in a well.
- Finally, the hydrocarbon saturation in different reservoir rocks can be calculated at the well site itself.

UNIT-I

Direct Methods: Mud logging- coring – conventional and sidewall coring - Core analysis.

Concepts of well logging: What is well logging? - Logging terminology-Borehole environment-Borehole temperature and pressure-Log header and depth scale-Major components of well logging unit and logging setup- Classification of well logging methods- Log presentation- Log quality control.

UNIT-II

Open hole logging: SP Logging- Origin of SP, uses of SP log-Calculation of salinity of formation water- Shaliness-Factors influence SP log.

Resistivity log: Single point resistance log (SPR)- Conventional resistivity logs- Response of potential and gradient logs over thin and thick conductive and resistive formations- Limitations of conventional resistivity tools. Focused resistivity log- Advantages of focused resistivity tools over conventional resistivity tools.

Micro resistivity log: Conventional and focused micro resistivity logs and their application.

Induction log: Principle of induction tool and the advantages. Criteria for selection of induction and lateral logging tool. Determination of true resistivity (Rt) of the formation-Resistivity index-Archie's equation.

UNIT-III

Gamma ray log: principle of radioactivity-Uses of gamma ray log- Determination of shaliness of formation-API counts- Calibration of Gamma ray tool-Statistical fluctuation-Time constant.

Natural Spectral Gamma ray log: Principle and application.

Caliper log: Principle and application of caliper tool.

Density log: Principle of density tool- Environmental corrections-Porosity determination-Tool calibration. Litho density log.

Neutron log: Principle and application of neutron tool. Porosity determination.

Sonic log: Principle and application of sonic log-Bore hole compensation-Determination of primary and secondary porosity, determination of mechanical properties of rock, elastic constants, fractures etc.

UNIT-IV

Cased hole logging: Gamma ray spectral log-Neutron decay time log-Determination of fluid saturation behind casing-Cement bond log- Casing collar log-Depth control- Perforation technique- Free point locater and Plug setting-Casing inspection logs.

Production logging: Solving production problems with the help of Fluid Density log-Temperature log and Flow meter logs.

UNIT-V

Advances in Well logging: Dip meter log-Formation tester-Cased hole resistivity logs - Nuclear magnetic resonance log & Scanner logs (Sonic scanner, MR scanner Rt scanner).

Outcome: Calculating the dip of the formations, collection of fluid samples from wells for confirmation of log interpretation, and also recording resistivity in cased holes.

Interpretation: Quick look interpretation- Cross plots. Neutron- Density, Sonic- Density, Sonic- Neutron cross plots-Hingle plot-Mid plot –Correlation- Hydrocarbon reserve estimate.

TEXT BOOKS:

1. Formation evaluation, Edward J. Lynch, Harper & Row, 1962.
2. Well logging and formation evaluation, Toby Darling, Elsevier, New York, 2005.
3. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip, 2007.

THERMODYNAMICS FOR PETROLEUM ENGINEERS

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **PE503PC**	**4 1/0/0 4**

Prerequisites: Engineering Mathematics, Engineering Physics

Course Objective: This course is to understand the laws of thermodynamics and their application in the analysis of chemical and engineering problems and to calculate thermodynamics properties of fluids and fluid mixtures using equation of state.

Course Outcome: Student should be able to identify a system and apply the laws of thermodynamics and should be able to estimate thermodynamic properties of substances in gas or liquid state

UNIT-I

Introduction: The scope of thermodynamics, defined quantities; temperature, volume, pressure, work, energy, heat, Joules Experiments, SI units.
The first law and other basic concepts**:** The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady flow process, equilibrium, the reversible process, constant-V and constant- P processes, heat capacity.

UNIT-II

Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, Cubic equations of state, generalized correlations for gases.
The second law of thermodynamics-1**:** Statements of the second law, heat engines, thermodynamic temperature scales, thermodynamic temperature and the ideal-gas scale.

UNIT-III

The second law of thermodynamics-2: Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics. Mollier diagram and steam tables.
Thermodynamics of flow processes; principles of conservation of mass and energy for flow systems, analysis of expansion processes; turbines, throttling; compression processes – compressors and pumps; calculation of ideal work and last work. Examples on hydrocarbons and natural gas.

UNIT-IV

Solution thermodynamics: Basic concepts of chemical potential, phase equilibria, partial properties, fugacity coefficient, residual and excess Gibbs free energy, correlations for the estimation of fugacity coefficient, residual and excess Gibbs energy in vapor liquid equilibria.

UNIT-V

Phase Equilibria: Gamma/Phi formulation of VLE, VLE from Virial equations of state, and cubic equations of state, Introduction to vapor- liquid–liquid equilibrium (VLLE), solid-liquid equilibrium (SLE), and solid vapor equilibrium (SVE), equilibrium adsorption of gases on solids. Correlations for petroleum fluids.

TEXT BOOK:

1. Introduction to Chemical Engineering Thermodynamics, J.M. Smith, H.C. Van Ness and M.M. Abbott, 7th ed. McGraw Hill, 2005.

REFERENCE BOOKS:

1. Characterization and Properties of Petroleum Fractions. M. R. Riaze, ASTM, USA, 2005.
2. Equation of state and PVT analysis. Tarek Ahmed, Gulf publishing company, Houston, 2007.

FUNDAMENTALS OF MANAGEMENT

B.Tech. III Year I Sem.	**L T P C**
Course Code: SM504MS	**3 0 0 3**

Course Objective: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

Course Outcome: The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT - I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT - II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT - III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.
Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT - IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT - V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency and Methods.

Text Books:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

References:

1. Essentials of Management, Koontz Kleihrich, Tata McGraw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

INSTRUMENTATION AND PROCESS CONTROL LAB

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **PE505PC**	**0 0/3/0 2**

Prerequisites: Basic knowledge of Instrumentation and Process Control

Course Objectives: Instrumentation and Process Control laboratory enables a "hands-on" environment that is important for developing students' understanding of theoretical ideas. Instrumentation and Process Control laboratory is equipped with different instruments like computer based temperature measurement, level detection, pressure measurement, flow measurement etc. and different types of valves, and operations in process control loop. On different panels or rigs these are arranged in different control configurations to achieve specific control objectives.

Course Outcomes: By the end of the course, students should be able to:

- develop awareness of safety in the laboratory so that all laboratory work is carried out in a safe manner
- develop the ability to carry out experimental investigations of processes which include creating equipment diagrams and comprehensive safe operating procedures for various unit operations
- determine a specific set of experimental objectives
- develop the ability to work in a team and develop confidence through the application of previously acquired knowledge of unit operations, chemical reactions, process safety, and process control
- learn how to apply software tools typically used by process control professionals

List of Experiments:

1. Calibration and determination of time lag of various first and second order instruments Major equipment - First order instrument like Mercury-in-Glass thermometer and Overall second order instrument like Mercury-in-Glass thermometer in a thermal well

2. Experiments with single and two capacity systems with and without interaction Major equipment- Single tank system, Two-tank systems (Interacting and Non-Interacting)

3. Level control trainer
   Major equipment - Level control trainer set up with computer

4. Temperature control trainer
   Major equipment - Temperature control trainer with computer

5. Cascade control
   Major equipment - Cascade control apparatus with computer

6. Experiments on proportional, reset, rate mode of control etc.
   Major equipment – PID control apparatus

7. Control valve characteristics
   Major equipment – Control valve set up

8. Estimation of damping coefficient for U-tube manometer
   Major equipment - U-tube manometer

9. Calibration of Mercury in glass thermometer

10 Calibration of Thermocouple

11 Calibration of Pressure Gauge

12 Calibration of Rotameter

WELL LOGGING AND FORMATION EVALUATION LAB

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: PE506PC	**0 0/3/0 2**

Prerequisites: Well Logging and Formation Evaluation

Course Objectives:

- To delineate hydrocarbons through direct and indirect means/methods.
- To determine lithology using different logs
- To estimate hydrocarbon and water saturation for geological formations

Course Outcome: The students will get the basic knowledge to interpret well logs for hydrocarbon and coal exploration.

List of Practicals:

1. To study SP and Gamma Ray logs to identify bed boundaries
2. To compute porosity of the formation using different types of input data
3. To compute water saturation from resistivity logs
4. To apply borehole correction on SP and resistivity logs
5. To apply borehole correction on gamma ray log
6. To calculate formation temperature
7. To calculate formation factor from resistivity log
8. To find out litho-inuts from different cross-plots
9. Use of porosity logs to distinguish oil and gas
10. To cross plot resistivity versus sonic travel time
11. To determine porosity from neutron density and sonic logs
12. To identify lithology using MN plots
13. To identify lithology using MID plots
14. To interpret dipmeter log
15. To interpret coal log data
16. To compute resistivity of formation water from SP logs

ENERGY AND ENVIRONMENTAL ENGINEERING LAB

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
Course Code: PE507PC	**0**	**0/3/0**	**2**

Prerequisites: Environmental Engineering and Energy Engineering

Course Objectives:
- To estimate pH, TDS & Conductivity, Hardness, Turbidity, Fluoride of ground & surface water
- To analyse the air to understand the pollution level
- To understand different parameters of fuel cell and concept of energy audit

Course Outcome: The student will be able to understand various aspects of energy and environment which are very much essential in the industry

List of Experiments:
1. Estimation of chemical and physical parameters of Ground and Surface water: pH, TDS & Conductivity, Hardness, Turbidity, Fluoride, Color analysis. Pesticide Microbial analysis: e-coli/ total coli forms bacteria
2. Estimation of physical parameters of waste water: pH, TDS, Hardness, Turbidity, Alkalinity etc.
3. Estimation of chemical parameters of waste water: COD, BOD, TSS
4. Water and waste water treatment: Small RO system for treatment of ground water. Same above system with UF membrane for turbidity removal and water disinfection.
5. Analysis of Air: Estimation of SPM, RSPM, Sox, Nox, CO and ozone in atmospheric air to study air pollution.
6. Fuel cell Test Kit [Energy]: A small ½ watt to 1 watt fuel cell with water electrolysis kit (H_2 and O_2 Generation) plus small volt meter and ammeter for measuring fuel cell performance (Three experiments can be conducted using this kit).
7. One small transparent anaerobic/aerobic biological reactor with slurry pump and aerator for treatment of industrial effluents to reduce COD levels.
8. Energy auditing of your Department.

List of Equipment:
pH meter, Colorimeter, TDS meter, Aerobic /Anaerobic reactor 25L capacity, BOD incubator, High accuracy analytical balance (5 digit), Desiccators, RO system with domestic 2''x12'' Membrane module, H_2S vial kit, Water analysis kit, UV-Vis spectrophotometer, High volume air sampler, Bomb calorimeter, Fuel cell test kit, Microscope.

PROFESSIONAL ETHICS

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: MC500HS	**3 0/0/0 0**

Course Objective: To enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

Course Outcome: The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT - I

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT- II

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT - III

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.

Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

UNIT - IV

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

UNIT - V

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

TEXT BOOKS:

1. Professional Ethics: R.Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

REFERENCES:

1. Engineering Ethics, Concepts Cases : Charles E Harris Jr., Michael S Pritchard , Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

PIPELINE ENGINEERING
(Professional Elective - I)

B.Tech. III Year II Sem. **L T/P/D C**
Course Code: PE611PE **3 0/0/0 3**

Course Objectives:

- To familiarize the students with the various elements and stages involved in transportation of oil and gas.
- To understand international standards and practices in piping design.
- To know various equipment and their operation in pipeline transportation.
- To understand modern trends in transportation of oil and gas

Course Outcome: The students would get an understanding of the key steps in a pipeline's lifecycle: design, construction, installation, asset management and maintenance.

UNIT-I

Elements of pipeline design: Fluid properties – Environment - Effects of pressure and temperature - Supply / Demand scenario - Route selection - Codes and standards - Environmental and hydrological considerations – Economics - Materials / Construction – Operation - Pipeline protection - Pipeline integrity monitoring.

Pipeline route selection, survey and geotechnical guidelines: Introduction - Preliminary route selection - Key factors for route selection - Engineering survey - Legal survey - Construction / As-built survey - Geotechnical design.

UNIT-II

Natural gas transmission: General flow equation – Steady state - Impact of gas molecular weight and compressibility factor on flow capacity - Flow regimes - Widely used steady-state flow equations – Summary of the impact of different gas and pipeline parameters on the gas flow efficiency – Pressure drop calculation for pipeline in series and parallel – Pipeline gas velocity – Erosional velocity – Optimum pressure drop for design purposes – Pipeline packing – Determining gas leakage using pressure drop method – Wall thickness / pipe grade – Temperature profile – Optimization process – Gas transmission solved problems.

UNIT-III

Gas compression and coolers: Types of compressors – Compressor drivers – Compressor station configuration – Thermodynamics of isothermal and adiabatic gas compression – Temperature change in adiabatic gas compression – Thermodynamics of polytropic gas compression – Gas compressors in series – Centrifugal compressor horsepower – Enthalpy / Entropy charts (Mollier diagram) – Centrifugal compressor performance curve – Influence of pipeline resistance on centrifugal compressor performance-Reciprocating compressors – Gas compression solved problems – Gas coolers – Air-cooled heat exchangers – Coolers heat transfer equations – Fan air mass flow rate – Required fan power – Gas pressure drop in coolers – Iterative procedure for calculations based on unknown T_2.

UNIT-IV

Liquid flow and pumps: Fully developed laminar flow in a pipe – Turbulent flow – Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow) – Pump station control – Pump station piping design.

Transient flow in liquid and gas pipelines: Purpose of transient analysis – Theoretical fundamentals and transient solution technique – Applications – Computer applications.

Pipeline mechanical design: Codes and standards – Location classification – Pipeline design formula – Expansion and flexibility – Joint design for pipes of unequal wall thickness.

UNIT-V

Materials selection and quality management: Elements of design – Materials designation standards – Quality management.

Pipeline construction: Construction – Commissioning.

Pipeline protection, Instrumentation, pigging & Operations: Pipeline coating – Cathodic protection – Cathodic protection calculations for land pipelines – Internal corrosion – Flow meters and their calibration – Sensors – Pigs-Pipeline Operations and maintenance.

TEXT BOOKS:

1. Pipeline Design and Construction: A Practical Approach, M. Mahitpour, H. Golshan and M.A. Murray, 2nd Edition, ASME Press, 2007.
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press), 2003.

REFERENCE BOOKS:

1. Piping Calculation Manual, E. Shashi Menon, McGraw-Hill, 2004.
2. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press, 2003.
3. Pipeline Planning and Construction Field Manual, E. Shashi Menon, Gulf Professional Publishing, 2011.
4. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7th Edition, 2009.
5. Liquid Pipeline Hydraulics, E. Shashi Menon, Mareel Dekker Inc., 2004.
6. Gas Pipeline Hydraulics, E. Shashi Menon, Taylor & Francis, 2005.

NATURAL GAS PROCESSING
(Professional Elective - I)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **PE612PE**	**3**	**0/0/0**	**3**

Course Objectives:

- To enhance student's knowledge about natural gas produced in the reservoirs, surface handling and processing equipment
- To educate student about knowledge of natural gas, basic chemical properties and physical laws
- To update student with the understanding of operations of separators, heaters and glycol dehydrators.

Course Outcome: The student would be able to describe the basic components of processing equipment and explain various gas plant operational procedures.

UNIT-I

Overview of natural gas Industry: Introduction- The world picture for natural gas- Natural Gas in India - Nonconventional gas reserves in India- Sources of natural gas- Natural gas compositions – Classification- Processing and principal products- Product specifications- Combustion characteristics- Overview of gas plant processing- Roles of gas plants - Plant processes.

Field operations and inlet receiving: Field operations- Gas hydrates Inlet receiving- Safety and environmental considerations.

UNIT-II

Gas treating: Introduction- Solvent absorption processes- Physical absorption- Adsorption- Cryogenic fractionation- Membranes- Nonregenerable hydrogen Sulfide scavengers- Biological processes- Safety and environmental considerations.

Gas dehydration: Introduction- Water content of hydrocarbons- Gas dehydration processes - Safety and environmental considerations.

UNIT-III

Hydrocarbon recovery: Introduction- Process components- Recovery processes - Safety and environmental considerations.

Nitrogen rejection: Introduction- Nitrogen rejection for gas upgrading- Nitrogen rejection for enhanced oil recovery- Safety and environmental considerations.

Trace component recovery or removal: Introduction-Helium-Mercury- (BTEX) Benzene, Toluene, Ethyl benzene, and Xylene.

UNIT-IV

Liquids processing: Introduction- Condensate processing- NGL processing- Safety and environmental considerations.

Sulphur recovery: Introduction- Properties of sulphur- Sulphur recovery - Sulphur storage- Safety and environmental considerations.

Transportation and storage: Introduction-Gas – Liquids.

UNIT-V

Liquefied Natural Gas: Gas treating before liquefaction- Liquefaction cycles- Storage of LNG- Transportation- Regasification and cold utilization of LNG- Economics - Plant efficiency - Safety and environmental considerations.

TEXT BOOK:

1. Fundamental of Natural Gas Processing, Arthur J. Kidnay, William R. Parrish, Taylor and Francis, 2006.

REFERENCES:

1. Natural Gas: A Basic Handbook, James G. Speight, Gulf Publishing Company, 2007.
2. Gas Conditioning and Processing, John M. Campbell, Volume 2, 7th Edition, Campbell Petroleum Series, 1992.
3. Gas Conditioning and Processing, Robert N. Maddox, Volume 3, 3rd Edition, Campbell Petroleum Series, 1982.
4. Petroleum & Gas Field Processing, H. K. Abdel – Aal, Mohamed Aggour and M. A. Fahim, Marcel Dekker, Inc., 2003.
5. Engineering Data Book 12th Edition (Electronic), FPS Version, Volume I & II, Gas Processers Suppliers Association (GPSA), 2005.
6. Handbook of Natural Gas Transmission and Processing, Saeid Mokhatab, William A. Poe, James G. Speight, Gulf Professional Publishing, 2006.
7. Surface Production Operations, Ken Arnold, Maurice Stewart, Volume 2, 2nd Edition, Elsevier Science, 1989.
8. Field Handling of Natural Gas, J. Leecraft, 4th Edition, PETEX, 2007.
9. Plant Processing of Natural Gas, Doug Elliot, J.C. Kuo, Pervouz Nasir, 2nd Edition, PETEX, 2012.

PETROCHEMICAL ENGINEERING
(Professional Elective - I)

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: PE613PE	**3 0/0/0 3**

Course Objectives: The course is designed to

- Impart knowledge to the students about the latest developments in petrochemical engineering.
- To understand the various feed stocks of petro-chemical and its products.
- To get acquainted with basic manufacturing processes of various petro-chemical products.

Course Outcome: The student would be in a position to have a knowledge of feed-stocks used in the petro-chemical engineering, various techniques used to produce various petrochemical products.

UNIT - I

Introduction: Petrochemical industry-Structures of petrochemical complexes-Feedstock for petrochemicals-Profile of petrochemicals and their end products-Indian Petrochemical industries-Profile of Indian petroleum and petrochemical Industry.

UNIT - II

Petrochemical Feed stocks-Naphtha cracking-Gas cracking and Gas reforming.
Chemicals from gas reforming: Methanol- Acetic acid- Ammonia and urea.
Production of ethylene & propylene: Separation of cracking products- Emerging technologies.

UNIT - III

Chemicals from C_2 and C_3 olefins: Ethylene oxide- MEG- Ethyl benzene-styrene. Acrylonitrile–butyraldehydes and butanols, 2-ethyl hexanol.
Polymers based on olefins: LDPE, HDPE & LLDPE and Polypropylene- and polystyrene.
C_4 based Chemicals and others: Butadiene–1-Butene–n-Butenes-Isobutylene–n-Butene–Octenes–1,4-Butanediol–Chloroprene–Isoprene- Maleic anhydride.

UNIT - IV

Aromatic production: Petroleum feedstock for aromatic hydrocarbons-Aromatic hydrocarbon production- catalytic reforming-Reactions in catalytic reforming-Reforming catalyst-Reforming process-Process variables in catalytic reforming-Pyrolysis gasoline as aromatics feedstock-Aromatic separation from reformate and pyrolysis gasoline- Emerging technologies for the production of BTX.

UNIT - V

Production of Chemicals based on aromatics: Phthalic anhydride–Linear alkyl benzene–Phenol— Nitrobenzene and aniline

Chemicals for Fibres: Cyclohexane– Caprolactam – Adipic acid –Adiponitrile–Hexamethylene diamene and Dimethyl terephthalete, Terephthalic acid –Polyester fibre (Polyethylene terephthalate)–Nylon 66–Nylon 6– Acrylic fibres.

TEXT BOOK:

1. Petrochemical Process Technology, ID Mall, Macmillan India Ltd., New Delhi. 2007.

REFERENCE BOOKS:

1. Chemistry of Petrochemical Processes, Sami Matar and Lewis F.Hatch, 2nd Edition, Gulf Publishing Company, Houston, 2000.
2. Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers, 1970.
3. Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company, 1989.
4. Petrochemical Production Processes, N.Naderpour, SBS Publishers, 2009.
5. Petrochemicals, B. K. Bhaskara Rao, Oxford & IBH Publishing, 2002.

DRILLING TECHNOLOGY

B.Tech. III Year II Sem. **L T/P/D C**
Course Code: PE601PC **4 0/0/0 4**

Prerequisites: Elements of Mechanical Engineering, Chemical Engineering Fluid Mechanics
Course Objectives:

- To understand various aspects involved in drilling a well including completion.
- To understand the plan of drilling a well, the process of drilling and various equipment used for drilling and design of the drill string.
- To know the drilling fluid importance and its properties and hydraulics.
- To understand different types of casings lowered in a well, the requirement of cementation in a well and cement slurry design.
- To understand different tools used for directional drilling and various techniques, fishing, stuck pipe and well control concepts.

Course Outcomes: The students will be able to

- apply the drilling concepts of a well from planning to rig mobilization to the location
- apply the concept of a drill string design for drilling
- decide the suitable drilling fluids during drilling
- do Casing and Cementation design
- carry out Directional drilling
- manage rouble shoot well control, stuck pipe and fishing problems
- to select the proper drilling equipment.

UNIT - I
Overview of drilling: Drilling plan- GTO -Types of drilling, Rotary bit technology- Drilling string basics. Drilling fluid properties- Drilling fluid hydraulics calculations- Bit Hydraulics-Optimization- Swab & Surge-pressures- Mud hydraulics analysis report- Lost circulation. Disposing of the drilling fluids waste and drill cuttings waste.

UNIT - II
Hydrostatic pressure, Pore pressure, Causes of abnormal pore pressure, abnormal pore pressure evaluation- Mud logging methods - Measurement while drilling & logging while drilling data-Direct measurements of pore pressure. Formation integrity tests – Fracture gradient determination – Theory of wellbore – FIT procedural Guidelines – Predicting fracture gradient HPHT well design.

UNIT - III
Wellbore stability–Determination of the magnitude and direction of the in situ stress Determination of rock properties, Failure criteria – Stress distribution around a wellbore Procedure for determining safe mud weights to prevent hole collapse Preventing borehole instability Gas behavior in a well – Kick tolerance How to calculate kick tolerance – Influence of FG on kick tolerance – Kick tolerance while drilling – Kick tolerance graph –

Modifying the calculate kick tolerance – Use of kick tolerance to calculate wellbore pressures.

UNIT - IV

Casing Functions of casing – Types of casing – Casing properties Casing specifications – Casing connections – Factors influencing casing design – Collapse criterion – Burst criterion – Combination strings – Tension criterion Compression loads – Biaxial effects – Triaxial analysis – Triaxial load capacity diagram Casing seat selection method.

Cementation: Introduction cement slurries-Typical field calculations- Cementing nomenclature- Cement additives – Cementation of liners.

UNIT - V

Directional drilling: Applications- Well planning- Down-hole motors- Deflection tools and techniques- Face orientation- Direction control with rotary assemblies- Navigation drilling systems.

Horizontal wells: Well profile design considerations – Torque and drag – Horizontal borehole stability – Extended reach well design – Multilateral wells.

Stuck pipe, well control: Kicks- Kick control- Pressure control theory- BOP-Special kick problems and procedures to free the pipes and Fishing operations. Types of fishing tools, Case studies of blow out control.

TEXT BOOKS:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
3. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.

REFERENCE BOOKS:

1. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
2. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.
3. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
4. Primer of Oil Well Service, Workover and Completion, Petroleum Extension Service, University of Texas at Austin, 1997.
5. Formulas and Calculation for Drilling, Production and workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
6. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
7. Well Engineering and Construction, Hussain Rabia, Entrac Consulting, 2002.
8. Drilling Fluids Processing Handbook, ASME Shale Shaker Committee, Gulf Professional Publishing, 2005.
9. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.

PETROLEUM RESERVOIR ENGINEERING

B.Tech. III Year II Sem. **L T/P/D C**
Course Code: PE602PC **4 0/0/0 4**

Prerequisites: Chemical Engineering Fluid Mechanics, Petroleum Geology, Chemical Process Calculations

Course Objectives:
- Recognize the central role of reservoir engineers in describing, evaluating and managing the reservoir system and, therefore, strive to gain a sound understanding of scientific principles used in the basic activities of reservoir engineering.
- Emphasize the impact of reservoir fluid behavior on reservoir exploitation.
- Understand the mechanics of oil and gas production in reservoirs and be able to apply the basic quantitative tools of reservoir engineering to analyze and/or predict the behavior of the reservoir under potentially useful production schemes.

Course Outcome: The student would be able to understand mechanics of oil production (natural reservoir energies and expulsion of fluids), and basic performance characteristics of various reservoir types to interpret performance characteristic curves for each reservoir type.

UNIT-I
Some basic concepts in Reservoir Engineering: Calculation of Hydrocarbon volumes – fluid pressure regimes – oil recovery and recovery factor – volumetric gas reservoir engineering – application of the real gas equation of state – gas material balance and recovery factor – Hydrocarbon phase behavior.
PVT analysis for oil: definition of the basic PVT parameters – collection of fluid samples – determination of the basic parameters in the laboratory and conversion for field operating conditions – alternative manner of expressing PVT lab analysis results – complete PVT analysis.

UNIT-II
Material balance applied to oil reservoirs : general form – the material balance expressed as a linear equation – reservoir drive mechanism – solution gas drive – gascap drive – natural water drive – compaction drive under related pore compressibility phenomena.
Darcy's law and applications: Darcy's law and field potential – sign convention – units and units conversion – real gas potential – datum pressures – radial steady state flow and well stimulation– two phase flow – effective and relative permeabilities.

UNIT-III
The basic differential equation for radial flow in a porous medium – derivation of the basic radial differential equation – conditions of solution – the linearization of the equation for fluids of small and constant compressibility.

Well inflow estimation for stabilized flow conditions: Semi - steady – state solution – steady state solution – example of the application of the stabilized inflow equations – generalized form of inflow equation under semi steady state conditions.

UNIT-IV

The constant terminal rate solution of the radial diffusivity equation and its application to oil well testing: The constant terminal rate solution – transient, semi steady state and steady state flow conditions – dimensionless variables – general theory of well testing – the Mathews, Brons, Hazebroek pressure build up theory - pressure build up analysis techniques – Multi Rate Drawdown testing – the effects of partial well completion – after flow analysis.

UNIT-V

Gas well testing: Linearization and solution of the basic differential equation for the radial flow of a real gas – the Russel, Goodrich etal. solution technique – the Al Hussainy, Ramey Crowford solution techniques – non– Darcy flow – determination of the non-Darcy coefficient F – the constant terminal rate solution for the flow of a real gas – general theory of gas well testing – multi rate testing of gas wells – pressure build up testing of gas wells – pressure build up analysis in solution gas drive reservoirs.

Natural Water influx: the unsteady state water influx theory of Hurst and Van Everdingen and its application in history matching – the approximate water influx theory of Fetkovitch for finite acquifiers predicting the amount of mater influx – application of influx calculation techniques to steam soaking .

TEXT BOOK:

1. Fundamentals of Reservoir Engineering , L.P. Dake, Elsevier Science, 1978 (17th Impression 1998).

REFERENCE BOOKS:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
3. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
4. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

PETROLEUM REFINERY ENGINEERING

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: PE603PC	**4 0/0/0 4**

Prerequisites: Engineering Chemistry, Chemical Process Calculations

Course Objectives:

- To understand the various feed stocks of refinery and petroleum products.
- To get acquainted with basic separation and conversion processes used in refining of crude oil.
- To get familiarized with challenges involved in refining from viewpoint of environment.

Course Outcome: The student would be in a position to have advanced knowledge of feed-stocks used in the refinery, various conversion processes used to produce various petroleum products.

UNIT - I

Introduction: Overall refinery operations & Indian scenario.

Refinery feed stocks: Crude oil classification-Composition and properties-Composition of petroleum crude suitable for asphalt manufacture – Crude distillation curves.

UNIT - II

Petroleum Products: Low boiling products – Gasoline – Gasoline specifications – Distillate fuels – Jet and turbine fuels – Automotive diesel fuels; Heating oils –Residual fuel oils; wax and asphalt-Product blending.

Crude distillation: Atmosphere topping unit – Vacuum distillation –Auxiliary equipment – Products of these two units.

UNIT - III

Thermal & catalytic processes: Visbreaking, Hydrovisbreaking, Thermal cracking – Catalytic cracking fluidized bed catalytic cracking and Hydrocracking - Feed stocks – Feed treating – Catalysts process variables – Yield estimation-Latest developments in cracking processes.

Coking: Types of petroleum coke-Properties and uses process description of delayed coking - Flexicoking and fluid coking – Yields.

UNIT - IV

Hydroprocessing and residue processing: Composition of vacuum tower bottoms – Processing options – Hydroprocessing options – Moving bed hydro processes – Solvent extraction Hydrotreating catalysts – aromatics
reduction – Process variables.

Catalytic reforming and isomerization: Catalytic reforming processes –Feed preparation & catalysts – Yields-Isomerization Processes and yields.

UNIT-V

Alkylation and polymerization: Alkylation feed stocks – Products –Catalysts – Hydrofluoric Acid and sulphuric acid alkylation processes –Comparison of processes-Polymerization processes.

Supporting processes: Hydrogen production and purification – Gas processing unit - Acid gas removal – Sulphur recovery processes – Waste water treatment and control of atmospheric pollution.

TEXT BOOK:

1. Petroleum Refining: Technology and Economics, J.H. Gary and G.E.Handwerk, 4th Edition, Marcel Dekkar, Inc., New York, 2001.

REFERENCE BOOKS:

1. Petroleum Refinery Engineering, W. L. Nelson, 4th Edition, McGraw Hill, New York, 1958.
2. Modern Petroleum Refining processes, 5th Edition, B. K. Bhaskara Rao, Oxford and IBH Publishing Co. Pvt. Ltd., 2008.
3. Practical Advances in Petroleum Processing, Chang S. Hsu and Paul Robinson, Vol. 1 & 2, Springer, 2006.

DRILLING FLUIDS LAB

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **PE604PC**	**0**	**0/3/0**	**2**

Prerequisites: Drilling Technology

Course Objectives:

- To inform the students about the primary functions of drilling fluid
- To introduce the test procedures for controlling the properties of drilling fluid
- To introduce the common additives used to obtain the desirable properties under various drilling conditions
- To explain main factors governing the selection of drilling fluids
- To improve technical report writing skills

Course Outcome:

- The students will be able to design desired drilling fluid.
- They will be aware of weighing additives and viscofiers.
- They can control filter loss.
- They can maintain hydrostatic pressure to prevent the well and rig from getting damage.

List of Experiments:

1. Determination drilling fluid weight.
   Equipment: Mud Balance
2. Determination of mud viscosity.
   Equipment: Marsh Funnel
3. Determination of pH of mud.
   Equipment: pH meter and Hydrion pH dispensers
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point).
   Equipment: Rheometer / Fann Viscometer
5. Determination of the loss of liquid from a mud.
   Equipment: Standard API Filter-press
6. Determination of a drilling mud cake and evaluate resistivity.
   Equipment: Fann Digital Resistivitymeter
7. Determination of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination).
9. Determination of solid and liquid content and emulsion characteristics of drilling fluid.
   Equipment: Sand Content Set, Fann Emulsion and Electrical Stability Tester
10. Oil, water, solid and clay content determination.
    Equipment: Oil-Water Retort Kit
11. Determination of water ratios for portland cement slurry.

(Effect of water ratio on free water separation normal and minimum water content and thickening time)
Equipment: The Atmospheric Consistometer

12. Determination of compressive strength of cement test moulds.
Equipment: Compressive Strength Testing Machine / UTM

PETROLEUM RESERVOIR ENGINEERING LAB

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: **PE605PC**	**0 0/3/0 2**

Prerequisites: Petroleum Geology, Reservoir Engineering

Course Objective: To make familiar students with reservoir fluid and rock properties such as Porosity, Permeability, Saturation, Wettability, Viscosity, Contact Angle, Surface Tension and Interfacial Tension

Course Outcome: The students should be in a position to
- predict the type of rock
- find out the amount of hydrocarbon in the reservoir
- determine the amount of recoverable hydrocarbon

List of Experiments
1. Determination of effective porosity by gas expansion method.
   Equipment: Helium Porosimeter (Nitrogen gas can be used in place of helium).
2. Determination of porosity and pore size distribution by mercury injection.
   Equipment: Mercury Porosimeter
3. Measurement of surface tension & interfacial tension with the ring tensiometer.
   Equipment: Ring Tensiometer
4. Determination of fluid density using Pycnometer and Hydrometer methods.
   Equipment: Pycnometer and Hydrometer
5. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
   Equipment: Capillary Tube Viscometer.
6. Determination of capillary pressure of reservoir rock (core) using porous plate method.
   Equipment: Capillary Pressure Cell
7. Measurement of contact angle (between oil, water and solid surface) using imaging method.
   Equipment: Image System Set-up
8. Measurement of Air Permeability.
   Equipment: Constant Head Permeameter with the Hassler cell / Gas Permeameter
9. Absolute permeability measurement of water.
   Equipment: Darcy Apparatus / Liquid Permeameter
10. Determination of relative permeability of oil-water using unsteady state method.
    Equipment: Relative Permeability Apparatus
11. Determination of relative permeability of gas-oil using unsteady state method.
    Equipment: Relative Permeability Apparatus

ADVANCED ENGLISH COMMUNICATIONS SKILLS LAB

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: **EN606HS**	**0 0/3/0 2**

Introduction:
A course on *Advanced English Communication Skills (AECS) Lab* is considered essential at the third year level of B.Tech and B.Pharmacy courses. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

Course Objectives: This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioral skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

Course Outcomes: Students will be able to:

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects
- Communicate confidently in formal and informal contexts

Syllabus:
The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Building Vocabulary** - Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations - Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.
2. **Reading Comprehension** –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.
3. **Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.

4. **Presentation Skills** – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments… etc.,
5. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process, Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

Minimum Hardware Requirement:

Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate acoustics**
- **Eight round tables with five movable chairs for each table.**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **Computer with suitable configuration**

Suggested Software: The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 8th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**

REFERENCES:

1. Kumar, Sanjay and Pushp Lata. ***English for Effective Communication***, Oxford University Press, 2015.
2. Konar, Nira. ***English Language Laboratories – A Comprehensive Manual,*** PHI Learning Pvt. Ltd., 2011.