JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. P.E.-II Sem

L	T/P/D	C
4	-/-/-	4

(A82726) PETROLEUM ECONOMICS, POLICIES & LAWS

Objectives:

- To emphasize the importance of time value of money in petroleum projects.
- To introduce the students to the theory and practices of Petroleum Economics to perform economic feasibility studies on prospective oil and gas properties.
- To understand the economic and decision analysis parameters in petroleum business.
- To understand the background of functioning of petroleum industry as an economic entity.
- To understand petroleum fiscal system within the context of India.

UNIT-I

Introduction to the oil industry: World supply and demand- Structure of the oil industry- Characteristics of crude oils and properties of petroleum products- Resources and development of natural gas.

Principles, methods & techniques of engineering economics: Time value in capital expenditures, Depreciation and depletion in oil projects- Financial measures and profitability analysis.

UNIT-II

Analysis of alternative selections and replacements- Risk, uncertainty and decision analysis- Break even and sensitivity analysis- Optimization Techniques.

Application and project evaluation: oil fields exploration and drilling operations-Oil fields estimation of oil reserves and evaluation of an oil property- Oil fields production operations- Oil transportation- Crude oil processing.

UNIT-III

Demand and marketing of petroleum products: The petroleum products in the principal consuming countries- The distribution of petroleum products- The marketing of petroleum products.

UNIT-IV

Natural gas: Natural gas supply in the world- Transportation- International Markets and prices.

Petrochemicals: General characteristics- economics of the two large basic units- The market for the principal finished products- Problems of today.

UNIT-V

Petroleum or Oil & Gas Rules and Regulations in India – The Oil fields Regulations and Development Act – New Exploration Licensing Policy (NELP) –Open Acreage Licensing Policy (OALP) - Functions of Directorate General of Hydrocarbons – Petroleum and Natural Gas Regulatory Board.

TEXT BOOKS:

1. Petroleum Economics and Engineering, H. K. Abdel-Aal, Bakr A. Bakr, M.A. Al-Sahlawi, 2nd Edition, Marcel Dekker Inc., 1992.
2. Petroleum Economics, Jean Masseron, 4th Edition, Editions TECHNIP, 1990.

(The instructor can download information required from internet to teach the topics in UNIT V).

Outcomes: The students would understand the basic features and technical foundations of Petroleum Economics, Policies & Laws and bridge the gap between the theory and the real world through practical applications based on up-to-date oil and gas projects.

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(A82727) RESERVOIR MODELING & SIMULATION

(Elective-III)

Objectives:

- To understand the importance and the fundamental concepts of reservoir simulation.
- To use a reservoir simulation package to solve complex fluid flow problems.
- To conduct a reservoir simulation study.

UNIT-I

Introduction: Milestones for the engineering approach-Importance of the engineering and mathematical approaches.

Single-phase fluid equations in multidimensional domain: Properties of single-phase fluid- Properties of porous media- Reservoir discretization- Basic engineering concepts- Multidimensional flow in Cartesian coordinates- Multidimensional flow in radial-cylindrical coordinates.

UNIT-II

Flow equation using CVFD terminology: Introduction- Flow equations using CVFD terminology- Flow equations in radial-cylindrical coordinates using CVFD terminology- Flow equation using CVFD terminology in any block ordering scheme.

UNIT-III

Simulation with a block-centered grid: Introduction- Reservoir discretization- Flow equation for boundary grid blocks- Treatment of boundary conditions- Calculation of transmissibilities- Symmetry and its use in solving practical problems.

Simulation with a point distributed grid: Introduction- Reservoir discretization- Flow equation for boundary grid points-Treatment of boundary conditions-Calculation of transmissibilities - Symmetry and its use in solving practical problems.

UNIT-IV

Well representation in simulators: Introduction- Single block wells- Multi block wells- Practical considerations dealing with modeling and well conditions.

Single-phase flow equations for various fluids: Pressure dependence of fluid and rock properties-General single-phase flow equation in multi dimensions.

UNIT-V

Linearization of flow equation: Introduction- Nonlinear terms in flow equations- Nonlinearity of flow equations for various fluids- Linearization of nonlinear terms- Linearized flow equations in time.

Methods of solution of linear equations: Direct solution methods- Iterative solution methods.

TEXT BOOK:

1. Petroleum Reservoir Simulation: A Basic Approach, Jamal H. Abou – Kasem, S. M. Fariuq Ali, M. Rafiq Islam, Gulf Publishing Company, 2006.

REFERENCE BOOKS:

1. Principles of Applied Reservoir Simulation, John R. Fanchi, Elsevier, 2005.
2. Practical Reservoir Simulation, M.R. Carlson, PennWell,2003.
3. Reservoir Simulation: Mathematical Techniques in Oil Recovery, Zhangxin Chen, Cambridge University Press, 2008.
4. Mathematics of Reservoir Simulation, Richard E. Ewing, Society for Industrial and Applied Mathematics (SIAM), 1983.

Outcomes: The student would be able to

- Apply various techniques to solve differential equations.
- Use numerical reservoir simulation to solve complex fluid flow problems.
- Execute a reservoir simulation project and suggest development plans for the reservoir.

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(A82724) MULTIPHASE FLOW IN POROUS MEDIA

(Elective - III)

Objective: The objective of this course is to introduce the basic theory and computational techniques for modeling multiphase flow in sub-surface porous media, especially applied to petroleum reservoir simulation. The students will also study conceptual and mathematical models that represent simplified scenario of petroleum reservoir.

UNIT-I

Introduction: Phases and porous media: Grain and pore size distribution- the concept of saturation – the concept of pressure – surface tension considerations – concept of concentration.

UNIT-II

Mass conservation Equation: Micro scale mass conservation – Integral form of mass conservation – Integral Theorems- point form of mass conservation – The macro scale perspective – The averaging theorem – Macro Scale mass Conservation – Applications

UNIT-III

Flow Equations: Darcy's Experiments, fluid properties – Equation of state for fluids- Hydraulic potential – single phase fluid flow- Two phase immiscible flow- The Buckley- Livertt Analysis.

UNIT-IV

Mass Transport Equations: Velocity in the species transport equations – Closure relations for the dispersion vector– Chemical Reaction Rate - Initial and boundary conditions.

UNIT –V

Simulation: 1-D simulation of Air-Water Flow- 1-D Simulation of DNAPL water flow – 2-D simulation of DNAPL Water flow – Simulation of multi phase flow and transport – 2-D single phase flow and transport – 3-D single phase flow and Transport– 2-D Three phase flow

TEXT BOOK:

Essential of multiphase flow in porous media, George F. Pinder and William G. Gray, Wiley Interscience, 2008

REFERENCE BOOK:

Multiphase flow in porous media, Kluwer Academic publisher, 1995

Outcomes:

The students would gain knowledge on core sample characterization and properties measurement. They would get a feeling for time-scales of porous media flow, fluid pressure and chemical diffusion. They would understand the natural variability of porous media and the scale-dependence of flow properties. They know about pattern formation in porous media flow and about key coarsening instabilities like thermal or chemical convection etc.

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(A82728) RESERVOIR STIMULATION

(Elective-III)

Objective: This subject discusses the various well stimulation treatments that are frequently used to stimulate old or poorly producing wells. It will cover the stimulation techniques as tools to help manage and optimize reservoir development. The course includes; acidizing and fracturing quality control, conducting the treatment, monitoring pressures, and other critical parameters, during and after the treatment.

UNIT-I

Reservoir justification of stimulation treatments: Introduction- Fundamentals of pressure transient analysis- Well and reservoir analysis.

Elements of rock mechanics: Basic concepts- Pertinent rock properties and their measurement- In-Situ stress and its determination.

UNTI-II

Modeling of hydraulic fractures: Conservation laws, and constitutive equations- Fracture propagation models- Fluid-Flow modeling- Acid fracturing.

Fracturing fluid chemistry: Water-Base fluids- Oil-Base fluids- Multiphase fluids- Additives- Execution.

UNIT-III

Fracturing fluid proppant and characterization: Rheology- Shear and temperature effects on fluid properties- Foam fracturing fluids- Slurry rheology- Proppant transport- Fluid loss- Formation and fracture damage- Proppants.

Pre-Treatment data requirements: Types of data- Sources of data- Dynamic downhole testing.

Fracturing diagnosis using pressure analysis: Basic relations- Pressure during pumping- Analysis during closure- Combined analysis pumping and closure- Field procedures.

UNIT-IV

Considerations in fracture design: Size limitations- Considerations with predetermined size or volume- Benefits of high proppant concentrations- Effect of reservoir properties- Effects of perforations on fracture execution.

Fracture-Height predictions and post-treatment measurements: Linear fracture-mechanics modeling for fracture height- Fracture-height prediction procedures- Techniques to measure fracture height.

Matrix acidizing of sandstones: Criteria for fluid selection- Organization of the decision tree- Preflush and postflush- Acidizing sandstones with mud acid- Other acidizing formulations- Matrix acidizing design.

UNIT-V

Fluid placement and diversion in sandstone acidizing: Techniques of fluid placement- Diverting agents.

Matrix acidizing treatment evaluation: Derivation of bottom hole parameters from wellhead measurements- Monitoring skin evolution during treatment.

Principles of acid fracturing: Comparison of acid Fracturing Vs Fracturing with propping agent and nonreactive fluids- Factors controlling the effectiveness of acid fracturing treatments- Acid fluid loss- Acid spending during fluid injection- Treatment design.

TEXT BOOK:

1. Reservoir Stimulation, Michael. J. Economides, Kenneth G. Nolte, 2nd Edition, Prentice Hall, 1989

REFERENCE BOOKS:

1. Oil Well Stimulation, Robert S. Schechter, Prentice Hall, 1992.
2. Modern Fracturing Enhancing Natural Gas Production, Michael J. Economides, Tony Martin, ET Publishing, 2007.

Outcomes: The student would be familiarized with the selection of stimulation techniques best suited for various formation types and situations, application of basic non-acid and acidizing concepts and also basic hydraulic fracturing concepts.

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4	-/-/-	4

(A80831) MEMBRANE TECHNOLOGY

(Elective-III)

Objective: This course will give the basic principles of membrane separation processes.

UNIT I

Introduction: Separation process, Introduction to membrane processes, definition of a membrane, classifications membrane processes.

Preparation of Synthetic membranes: Types of Membrane materials, preparation of Synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, and preparation technique for composite membranes.

UNIT II

Characterization of membranes; Introduction, membrane characterization, characterization of porous membranes, characterization of non-porous membranes.

Transport in membranes: introduction, driving forces, non equilibrium thermodynamics, transport through porous, non-porous, and ion exchange membranes.

UNIT III

Membrane Processes: Introduction, osmosis, pressure driven membrane processes: Introduction, microfiltration, membranes for microfiltration, industrial applications, ultrafiltration: membranes for ultrafiltration, industrial applications, reverse Osmosis and nanofiltration: membranes for reverse osmosis and nanofiltration, industrial applications, Electrically Driven processes: Introduction, electrodialysis, Process parameters, membranes for electrodialysis, applications, Membrane electrolysis, Biopolar membranes, Fuel Cells

UNIT IV

Concentration driven membrane processes: gas separation: gas separation in porous and non porous membranes, membranes for gas separation, applications, pervaporation, membranes for pervaporation, applications, dialysis: membranes for dialysis, applications, liquid membranes: aspects, liquid membrane development, choice of the organic solvent and carrier, applications, introduction to membrane reactors,

UNIT V

Polarization phenomenon and fouling: Introduction to concentration polarization, turbulence promoters, pressure drop, gel layer model, osmotic pressure model, boundary layer resistance model, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling, compaction. Module and process design: Introduction, plate and frame module, spiral wound module, tubular module, capillary module, hollow fiber module, comparison of module configurations.

TEXT BOOKS:

1. Membrane Separations, M.H.V. Mulder, Springer Publications, 2007
2. Rate-Controlled Separations, P. C. Wanket, Elsevier Applied Science, London,1994.

REFERENCES:

1. Membrane Technology in the Chemical Industry, S.P. Nunes, K.V. Peinemann, Wiley-VCH
2. Membrane Processes in Separation and Purification, J.G.Crespo, K.W.Bodekes, Kluwer Academic Publications.
3. Membrane Separation Processes, K. Nath, PHI Pvt. Ltd., New Delhi,2008.

Outcome: The student will understand the underlined principles and importance of ultrafiltration, reverse Osmosis, electrodialysis, nanofiltration, etc., in industrial waste water treatment.

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IV Year B.Tech. P.E.-II Sem

L	T/P/D	C
4	-/-/-	4

(A82725) NATURAL GAS HYDRATES

(Elective-IV)

Objective: The main objective of the course is to give the students a fundamental understanding of natural gas hydrates and corresponding implications with respect to thermodynamic stability as well as initiation of hydrate and corresponding strategies for hydrate prevention with respect to design of process equipment and addition of chemicals.

UNIT-I

Introduction: Overview of natural gas hydrates- Natural gas- Water molecule- Hydrates- Water and natural gas- Free-Water- Heavy water- Units.

Hydrate types and formers: Type I hydrates- Type II hydrates- Size of the guest molecule- n-Butane- Other hydrocarbons and non hydrocarbon molecules- Chemical properties of potential guests- Liquid hydrate formers- Type H hydrates- Hydrate forming conditions- Pressure-Temperature- Composition- Other hydrate formers- Mixtures- Examples.

UNIT-II

Hydrate formation hand calculation methods: Gas gravity method- K-Factor method- Baillie-Wichert method- Comments on these methods- Examples.

Hydrate formation computer methods: Phase equilibrium- Van der Waals and Platteeuw- Parrish and Prausnitz-Ng and Robinson methods- Calculations- Commercial software packages- Accuracy of these programs- Dehydration- Examples.

UNIT-III

Inhibiting hydrate formation with chemicals: Freezing point depression- Hammerschmidt equation- Nielsen-Bucklin equation- New method- Brine solutions- Comment on the simple methods- Advanced calculation methods- Inhibitor vaporization- Comment on injection rates- Kinetic inhibitors- Examples.

UNIT-IV

Combating hydrates using heat and pressure: Use of heat- Heat loss from a buried pipeline- Line heater deign- Two-Phase heater transfer- Depressurization- Melting a plug with heat- Examples.

Physical properties of hydrates: Molar mass - Density- Enthalpy of fusion- Heat capacity- Thermal conductivity- Mechanical properties- Volume of gas in hydrate- Ice versus hydrate- Examples.

UNIT-V

Phase diagrams: Phase rule- Comments about phases- Single component systems- Binary systems- Phase behavior below 0°C- Multicomponent systems- Examples.

Water content of natural gas: Equilibrium with liquid water- Equilibrium with solids- Examples.

TEXT BOOKS:

1. Natural Gas Hydrates: A Guide for Engineers, John J. Carroll, Gulf Professional Publishers, 2003.
2. Clathrate Hydrates of Natural Gases, E. Dendy Sloan, Jr., C. Koh, 3rd Edition, CRC Press, 2007.

REFERENCE BOOK:

1. Natural Gas Hydrates in Flow Assurance, E. Dendy Sloan, C. Koh, A. K. Sum, A. L. Ballard, J. Creek, M. Eaton, N. McMullen, T. Palermo, G. Shoup and L. Talley, Elsevier, 2010.

Outcomes: The students would gain knowledge of the properties, specifications and end uses of natural gas, gain a deeper understanding of typical natural gas hydrates formations.

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L	T/P/D	C
4	-/-/-	3

(A82723) GREEN FUEL TECHNOLOGIES
(Elective-IV)

Objective:

This course is designed with an objective to develop basic understanding of renewable and clean energy bio-fuels and their engineering aspects.

UNIT-I

Introduction – Plant based biofuels Scenario – Thermo chemical conversion of Biomass to liquids and Gaseous Fuels.

UNIT-II

Bioethanol from Biomass: Production of Ethanol from Molasses – Bioethanol form Starchy Biomass: Production of Starch Saccharifying Enzymes – Hydrolysis and Fermentation. Bioethanol from Lignocellulosic Biomass

UNIT-III

Bioethanol production Technologies and Substrates- Biodiesel Production using Pongamia Pinnata, Jatropha, Palm oil and used oils.

UNIT-IV

Microbial production of Methane- Different Types of Bio-digesters and Biogas Technology in India

UNIT-V

Hydrogen production by Fermentation- Microbial fuel cells

TEXTBOOKS:

1. Hand book of plant Based Biofuels, Ashok Pandey, CRC Press. 2009
2. Biofuels Engineering Process Technology, Caye M, Drapcho, Nghiem, Phu Nhuan, Terry H. Walker, McGraw-Hill, 2008

Outcomes: The students would learn about the importance of bio-fuels in achieving energy security and minimizing greenhouse gases emissions, the overview of available renewable and alternative clean energy sources like biomass resources, types of bio-fuels.

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IV Year B.Tech. P.E.-II Sem

L	T/P/D	C
4	-/-/-	4

(A82722) ADVANCED NATURAL GAS ENGINEERING

(Elective- IV)

Objectives:

- To learn and be able to apply the basic quantitative tools of reservoir and production engineering techniques to analyze and/or predict the mechanics of natural gas flow through the reservoir–production-transportation system.
- To understand the importance of evaluating and managing the reservoir-production system of gas reservoirs.
- To familiarize with various principles/ involved in natural gas engineering.

UNIT-I

Basics of Natural Gas: Natural Gas Origin-Accumulation-Natural Gas Resources- Natural Gas Composition & Phase Behavior- Natural Gas Properties.

Unique Issues in Natural Gas Exploration, Drilling & Well Completion

UNIT-II

NG Production: Darcy and non-Darcy flow in porous media, Gas well inflow under Darcy flow-Gas well inflow under non-Darcy flow- Horizontal Gas well inflow-Hydraulic fracturing- well deliverability-forecast of well performance and material balance

UNIT-III

Natural Gas Transportation- properties and compressed natural gas.

Natural gas pipelines- marine compressed natural gas transportation.

UNIT–IV

Liquefied Natural Gas (LNG): LNG liquefaction- LNG carrier

Gas to liquids (GTL): GTL process – GTL based on direct conversion of natural gas – GTL based indirect conversion natural gas- GTL Economics

UNIT–V

Underground Natural Gas storage: Types of underground storage- storage measures

Natural gas supply, alternative energy sources and the environment: Advantages of fossil fuels, energy interchangeability-Regional gas supply potential

TEXT BOOK:

Advanced natural gas engineering, Xiuli Wang and Michael Economides, Gulf publishing company, Houston, Texas, 2009.

REFERENCE BOOK:

Handbook of Natural Gas Engineering, D.L.Katz, Mc.Graw Hill, 1959

Outcomes: The students would be able to

- Understand basic fluid phase behavior, and be able to determine the physical properties of natural gas.
- Able to use volumetric method, material balance equation and decline curves to perform reserves and performance prediction/enhancement of dry and wet gas reservoirs.

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IV Year B.Tech. P.E.-II Sem

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(A80825) TRANSPORT PHENOMENA
(Elective-IV)

Objective: To assimilate the transfer processes in a unified manner.

UNIT I

Momentum Transport: Viscosity and the Mechanism of Momentum Transport (i) Newton's Law of Viscosity, (ii) Non-Newtonian fluids.

Velocity distributions in laminar flow: (i) Shell momentum balances boundary conditions (ii) Flow of a falling film, (iii) Flow through a circular tube (iv) Flow through an annulus.

The Equations of change for isothermal systems: (i) The equations of continuity, motion and mechanical energy in rectangular and curvilinear coordinates, (ii) Use of the equations of change to set up steady flow problems (iii) Dimensional analysis of the equations of change.

UNIT II

Momentum Transport: Velocity distributions with more than one independent variable (i) Flow near a wall suddenly set in motion. (ii) Unsteady laminar flow in a circular tube.

Velocity distributions in Turbulent flow: (i) Fluctuations and time smoothed quantities, (ii) Time-smoothing of the equations of change for an incompressible fluid, (iii) Semi-empirical expressions for the Reynolds stresses.

Interphase transport in isothermal systems: (i) Definition of friction factors (ii) Friction factors for flow in tubes (iii) Friction factors for flow around spheres.

UNIT III

Energy Transport: Thermal conductivity and the mechanism of energy transport: (i) Fourier's law of heat conduction.

Temperature distributions in solids and in laminar flow: (i) Shell energy balances - boundary conditions (ii) Heat conduction with an electrical heat source (iii) Heat conduction with a viscous heat source (iv) Heat conduction through composite walls (v) Forced convection and (vi) Free convection.

The equations of change for non-isothermal systems : (i) The equation of energy in rectangular and curvilinear coordinates, (ii) the equations of motion for forced and free convection in non-isothermnal flow (iii)Tangential flow in an annulus with viscous heat generation. and (iv) Dimensional analysis of the equations of change.

Temperature distribution with more than one independent variable : Heating of a semi-infinite slab only.

UNIT IV

Energy Transport: **Temperature distribution in turbulent flow**: (i) Temperature fluctuations and time-smoothed temperature, (ii) Time smoothing the energy equation (iii) Semi empirical expressions for the turbulent energy flux.

Interphase transport in non-isothermal systems : (i) Definition of the heat transfer coefficient (ii) Heat transfer coefficients for forced convection in tubes and around submerged objects, and (iii) Heat transfer coefficients for free convection.

Mass Transport: Diffusivity and the mechanism of mass transport : (i) Definitions of concentrations, velocities, and mass fluxes (ii) Fick's law of Diffusion.

Concentration distribution in solids and in laminar flow : (i) Shell mass balances - boundary conditions, (ii) Diffusion through a stagnant gas film, (iii) Diffusion with heterogeneous chemical reaction (iv) Diffusion with homogeneous chemical reaction and (v) Diffusion into a falling liquid film.

UNIT V

Mass Transport: The equations of change for multicomponent systems : (i) The equations of continuity for a binary mixture (ii) The equations of continuity of A in curvilinear coordinates and (iii) Dimensional analysis of the equations of change for a binary isothermal fluid mixture.

Concentration distributions in turbulent flow : (i) Concentration fluctuations and the time smoothed concentration (ii) Time-smoothing of the equation of continuity of A.

Interphase transport in multicomponent systems: (i) Definition of binary mass transfer coefficients in one phase, (ii) Correlations of binary mass-transfer coefficients in one phase at low mass-transfer rates (iii) Definition of binary mass-transfer coefficients in two phases at low mass-transfer rates, and (iv) Definition of the transfer coefficients for high mass transfer rates.

TEXT BOOK:

1. Transport Phenomena - R Byron Bird, Warran E Steward and Edwin N Lightfoot, John Wiley & Sons, Inc. New Y

REFERENCE BOOKS:

1. Transport Phenomena - Robert S Brodkey and Harry C Hershey, Mc Graw Hill Book Company, New York Tokyo-Toronto.
2. Transport Phenomena for Engineers - Louis Theodore, International Text-book Company, London.

3. Transport Phenomena - W.J. Book and K.M.K. Multzall, John Wiley & Sons Ltd, London, New York;
4. Fundamentals of Momentum, Heat and Mass Transfer - Mames R Welty, Charles E Wicks and Robert E Wilson, John Wiley & Sons Inc. New York.
5. Fluid Dynamics and Heat Transfer by James G Knudsen and Donald L. Katz, McGraw Hill Book Co. Inc., New York.

Outcome: Ability to analyze the processes involving simultaneous flow, heat and mass transfer, to design packed bed flows and fluidization processes, to calculate heat and mass transfer.

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(A80087) INDUSTRY ORIENTED MINI PROJECT

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. P.E.-II Sem

L	T/P/D	C
-	-/6/-	2

(A80089) SEMINAR

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. P.E.-II Sem

L	T/P/D	C
-	-/15/-	10

(A80088) PROJECT WORK

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. P.E.-II Sem

L	T/P/D	C
-	-/-/-	2

(A80090) COMPREHENSIVE VIVA