BRANCH: ***Applied Electronics and Instrumentation/ Electronics and Instrumentation Engineering***

SEMESTER - 8

Course Code	*Course Name*	*L-T-P*	*Credits*	*Exam Slot*
AE402	Analytical Instrumentation	3-0-0	3	A
AE410	Power Plant Instrumentation	3-0-0	3	B
	Elective4	3-0-0	3	C
	Elective 5 (Non Departmental)	3-0-0	3	D
AE492	Project		6	S

Total Credits = 18 **Hours: 30** **Cumulative Credits= 180**

Elective 4:-

1. AE462 Optimal Control System
2. AE464 Non-Linear Control System
3. AE466 Industrial Robotics
4. AE468 Nano Electronics
5. AE472 Petroleum Engineering

Course code	Course name	L-T-P-Credits	Year of Introduction
AE402	ANALYTICAL INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To review background information required for studying virtual instrumentation.
- To study the basic building blocks of virtual instrumentation.
- To study the various graphical programming environment in virtual instrumentation.
- To study a few applications in virtual instrumentation.

Syllabus

Fundamentals of analytical instruments –Classification of instrumental techniques - Electromagnetic radiation- Electromagnetic spectrum- Absorption spectroscopy - Ultra violet and visible absorption spectroscopy - Colorimeters/ photometers - Spectro photometers - Infra red spectroscopy - Atomic absorption spectrophotometers - Fluorescence spectroscopy - Raman spectrometer - Mass spectrometer - Nuclear Magnetic Resonance spectroscopy - Electron spectroscopy - X- Ray spectrometers - Chromatographic process – Classification - Gas chromatography - Liquid Chromatography - High pressure Liquid Chromatography - Industrial Gas analysers - Gas analysers - Blood PH measurement – Thin film technology for gas sensors- Thermal Sensors.

Expected outcome

- At the end of the semester students will be able to obtain comprehensive knowledge in analytical instrumentation and some of its applications.

Text Books

1. Skoog, Holler, Nieman, "Principles of Instrumental Analysis", Thomson books-cole publications, 5th edition.
2. Willard, Merritt, Dean, Settle , "Instrumental Methods of Analysis", CBS Publishers & Distributors, New Delhi, Seventh edition.

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Reference Books

1. Galen W. Ewing, "Instrumental Methods of Chemical Analysis", , McGraw-Hill Book Company, Fifth edition.
2. R. S. Khandpur , "Handbook of Analytical Instruments", , Tata McGraw–Hill Publications, 3rd edition.
3. Robert D. Braun, "Introduction to Instrumental Analysis", , McGraw-Hill Book Company

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction to Analytical Instrumentation: Fundamentals of analytical instruments: Elements of an analytical instrument – PC based analytical instruments –Classification of instrumental techniques. Electromagnetic radiation- Electromagnetic spectrum- Laws relating to absorption of radiation. Absorption spectroscopy: Absorption instruments – Radiation sources- Optical filters- Monochromators- Detectors. Ultra violet and visible absorption spectroscopy.	6	15%
II	Colorimeters/ photometers: Single beam and double beam filter photometer – Spectro photometers: Single beam and	7	15%

	double beam spectro photo meters- Infra red spectroscopy: Basic components- Radiation sources- Monochromators- Detectors. Flame Photometry: Principle and constructional details of flame photometer- Emission system – Optical system – Detectors. Atomic absorption spectrophotometers: Theoretical concepts, Instrumentation: Radiation sources - Burners and flames - Plasma excitation sources - Optical and electronic system.		
FIRST INTERNAL EXAMINATION			
III	Fluorescence spectroscopy: Principle of fluorescence – Measurement of fluorescence – Single beam and double beam filter fluorimeter- Ratio fluorimeter. Spectro fluorimeters. Raman spectrometer- Basic theory-Photo acoustic spectroscopy- Photo thermal spectroscopy. Mass spectrometer: Principle of operation- Magnetic deflection mass spectrometers- Components of a mass spectrometer – Inductively coupled plasma mass spectrometer.	7	15%
IV	Nuclear Magnetic Resonance spectroscopy: Basic principle – Constructional details of NMR spectrometer – Nuclear radiation detectors. Electron Spin Resonance spectrometer: Basic ESR spectrometer – Electron spectroscopy: Instrumentation for electron spectroscopy. X- Ray spectrometers: X – ray spectrum –Instrumentation for x –ray spectrometry. X-ray diffractometers- X-ray absorption meters- X- ray fluorescence spectrometry.	7	15%
SECOND INTERNAL EXAMINATION			
V	Chromatography: Chromatographic process – Classification- Terms in chromatography- Gas chromatography: Block diagram- Principle - Constructional details – Column details- GC detectors. Liquid Chromatography: Types of liquid chromatography- High pressure Liquid Chromatography (HPLC): Principle- Constructional details.	7	20%
VI	Industrial Gas analyzers- pH meters- Conductivity meters - Dissolved oxygen meters- Sodium analyser– Gas analysers- Paramagnetic oxygen analyser – CO analysers – Flue gas analysers- Blood PH measurement – Thin film technology for gas sensors- Basic concepts. Measurement techniques and application of gas sensors. Thermal Sensors:- Radiation Sensors, Mechanical Sensors and Bio-Chemical sensors.	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course name	L-T-P-Credits	Year of Introduction
AE410	POWER PLANT INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To introduce the basics of Power generation
- To enable the design of power plant control using various methods

Syllabus

Survey of methods of power generation-Boiler -P & I diagram of boiler -Measurement in boiler and turbine-Measurements in power plants -Controls in boiler-Nuclear power plant instrumentation.

Expected outcome

At the end of the semester students will be

i. Familiar with the basics of Power plant and power generation.
ii. Familiar with the design of Analysers and control loops used in power plant.

Text Books

1. Gill A.B, "*Power Plant Performance*", Butterworth, London, 1984.
2. P.C Martin, I.W Hannah, "*Modern Power Station Practice*", British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992.
3. Sam. G.Dukelow, "*The Control of Boilers*", 2nd Edition, ISA Press, New York, 1991

Reference Books

1. David Lindsley, "*Boiler Control Systems*", McGraw Hill, New York, 1991.
2. Jervis M.J, "*Power Station Instrumentation*", Butterworth Heinemann, Oxford, 1993.
3. Modern Power Station Practice, Vol.6, *"Instrumentation, Controls and Testing*", Pergamon Press, Oxford, 1971.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Brief survey of methods of power generation-hydro, thermal, nuclear, solar and wind power Introduction to thermal power plant processes – building blocks - ideal steam cycles	6	15%
II	Boiler – types, Boiler - turbine units and its range systems, feed water systems, steam circuits, air preheating. Soot blowers, combustion process, products of combustion, fuel systems, treatment of flue gases, smoke density measurements, steam turbine, condensate systems, alternator, feed water conditioning, turbine bypass valves. Importance of instrumentation in power generation – details of boiler processes, combined cycle power plant, power generation and distribution, burner tilting, and bypass damper.	7	15%
FIRST INTERNAL EXAMINATION			
III	Measurement in boiler and turbine: Metal temperature measurement in boilers, piping	7	15%

	System for pressure measuring devices, smoke and dust monitor, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement.		
IV	Measurements in power plants: Electrical measurements – current, voltage, power, frequency, power factor etc. – non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.	7	15%
SECOND INTERNAL EXAMINATION			
V	Controls in boiler: Boiler drum level measurement methods, feed water control, soot blowing operation, steam temperature control, Coordinated control, boiler following mode operation, turbine following mode operation, selection between boiler and turbine following modes. Distributed control system in power plants interlocks in boiler operation. Cooling system, Automatic turbine runs up systems.	8	20%
VI	Nuclear power plant instrumentation: Piping and instrumentation diagram of different types of nuclear power plant, Nuclear reactor control loops, reactor dynamics, pulse channel and logarithmic instrumentation, control and safety instrumentation, reliability aspects.	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course name	L-T-P-Credits	Year of Introduction
AE462	OPTIMAL CONTROL SYSTEM	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To formulate various types of optimal control problems
- To learn calculus of variations and dynamic programming for solving optimal control problems

Syllabus

Optimal control problem formulation. Dynamic optimization- Unconstrained Problems - Calculus of Variations. Continuous time and Discrete time Linear Quadratic regulator and Tracking problems-LQG Problems. Constrained Problems- Pontryagin's Minimum Principle-Dynamic Programming-Constrained Problems.

Expected outcome

The students will be able to

i. Understand the concepts related to calculus of variations and optimal control theory
ii. Apply the optimal control concepts to formulate and solve various types of control problems

Text Books:

1. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall networks series, 1970
2. M.Gopal, "Modern Control System Theory", Wiley Eastern, New Delhi, second Edition, 1993

References:

1. Brian D O Anderson and John B Moore, "Optimal Control - Linear Quadratic Methods", Prentice Hall of India, 1991
2. Desineni Subbaram Naidu, Optimal Control System, CRC press
3. Sage.A.P & White.C.C, Optimum Systems Control, Prentice Hall

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Optimal control problem - Problem formulation – Mathematical model – Physical constraints – Performance measure – Optimal control problem – Form of optimal control – Performance measures for optimal control problem – Selection of performance measure -Open loop and closed loop form of optimal control. Performance measures for optimal control problems – General form of performance measure	4	15%
II	Fundamental concepts and theorems of calculus of variations – Euler - Lagrange equation and extremal of functionals - the variational approach to solving optimal control problems - Hamiltonian and different boundary conditions for optimal control problem	6	15%
	FIRST INTERNAL EXAMINATION		
III	LINEAR QUADRATIC OPTIMAL CONTROLSYSTEM - Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case-	8	15%

	Time-invariant case – Stability issues of Time-invariant regulator, Linear Quadratic Tracking system: Finite time case and Infinite time case— Optimal solution of LQR problem. - Different techniques for solution of algebraic Riccati equation-- LQG Problem		
IV	DISCRETE TIME OPTIMAL CONTROL SYSTEMS Variational calculus for Discrete time systems – Discrete time optimal control systems:-Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control, Closed loop optimal control matrix difference Riccati equation – optimal cost function Discrete time linear state regulator system – Steady state regulator system	8	20%
SECOND INTERNAL EXAMINATION			
V	Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming –Interpolation-A recurrence relation of dynamic programming-Computational procedure for solving Control problems-Discrete linear regulator problems, Hamilton Jacobi-Bellman Equation – Continuous linear regulator problems	9	20%
VI	CONSTRAINED OPTIMAL CONTROL SYSTEMS – Pontryagin's minimum principle and sate inequality constraints –Minimum Time optimal problems Minimum control effort Problems – Optimal Control problems with State Constraints	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course name	L-T-P-Credits	Year Of Introduction
AE464	NON-LINEAR CONTROL SYSTEM	3-0-0-3	2016

Prerequisite : AE301 Control system

Course objectives

- To familiarize the modelling of simple mechanical systems.
- To analyse stability of nonlinear control systems

Syllabus

Linear vs non-linear system - Common Nonlinearities in control systems - mass spring system - method of iscoclanes- phase plane analysis of linear systems- phase plane analysis of non-linear systems- bendixon theorems - Describing Function Fundamentals -Describing functions of common nonlinearities - Concepts of Stability- Linearization and Local Stability - Lyapunov's Direct Method - Generation of Lyapunov functions -Popov's stability criterion - Non-Linear control system design-stabilisation problems-tracking problems - Issues in constructing non-linear controllers- available methods of non-linear control design.

Expected outcome

- At the end of the semester students must be able to understand and analyse the different behaviour of system performances and Stability technique.

Text Books

1. Jean Jacques Slotine and Weiping Li , "Applied Nonlinear Control", Prentice Hall Inc., 1991.
2. H. K. Khalil., "Nonlinear Systems", Pearson Education, 3rd Ed.
3. M Gopal "Digital Control and State Variable Methods", Tata McGraw-Hill Ltd, New Delhi, 2003.
4. Nagoor Kani, "Advanced Control System", Rba Publications

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction: Linear vs non-linear system- non-linear systems and equilibrium points- non–linear system behavior-examples-Common Nonlinearities in control systems-Autonomous and non-autonomous systems-modelling of simple pendulum- mass spring system-analysis and design of nonlinear system.	7	15%
II	Phase Plane Analysis: Singular points-construction of phase portraits- method of iscoclanes- phase plane analysis of linear systems- phase plane analysis of non-linear systems- local behaviour of non-linear systems-limit cycles- Stability- poincare- bendixon theorems.	7	15%
	FIRST INTERNAL EXAMINATION		
III	Describing Function: Describing Function Fundamentals - Describing functions of common nonlinearities-hysteris, backlash, relay, deadzone, saturation and combined effects-stability analysis and limit cycles.	7	15%
IV	Stability of nonlinear systems-Lyapunov theory (review)-autonomous and non-autonomous systems equilibrium points, Stability in the sense of Lyapunov, asymptotic stability and exponential stability, Linearization and local	7	15%

	stability, Lyapunov's direct method, positive definite functions and Lyapunov functions, Lyapunov theorem for local stability and global stability		
SECOND INTERNAL EXAMINATION			
V	Analysis based on Lyapunov's direct method-LTI systems-Krasovskii's method, Variable gradient method for constructing Lyapunov functions-simple examples, Popov's stability criterion. Stability of non-autonomous systems (basic concepts only)- Lyapunov's direct method – simple problems.	7	20%
VI	Non-Linear control system design-stabilisation problems-tracking problems-relations between stabilization and tracking problems-desired behaviour of nonlinear systems-Issues in constructing non-linear controllers- available methods of non-linear control design.	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course name	L-T-P-Credits	Year of Introduction
AE466	INDUSTRIAL ROBOTICS	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To familiarise automation and brief history of robot and applications.
- To study the kinematics of robots.
- To give knowledge about robot end effectors and their design.
- 4. To learn about Robot Programming methods & Languages of robot.

Syllabus

Automation and Robotics-configuration of robots-introduction to manipulator kinematics- Basic control system models-Robot actuation and feedback components- General considerations in robot material handling- Robot Programming and AI -Robot cell layouts - robot cycle time analysis

Expected outcome

The students will

i. be equipped with the automation and brief history of robot and applications.
ii. be familiarized with the kinematic motions of robot.
iii. have good knowledge about robot end effectors and their design concepts.

Text Books

Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, *"Robotic Engineering - An Integrated Approach"*, Prentice Hall India, 2002

Reference books:

1. Deb S.R., " *Robotics Technology and Flexible Automation* ", Tata McGraw-Hill, Publishing Co., Ltd., 1994.
2. K.S. Fu., R.C.Gonalez, C.S.G.Lee, *" Robotics Control Sensing* ", Vision and Intelligence, McGraw Hill International Edition, 1987.
3. Mikell P. Groover, Mitchell Weiss, "*Industrial Robotics, Technology, Programming and Applications* ", McGraw Hill International Editions, 1st Edition, 2000

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Automation and Robotics, Robot anatomy, configuration of robots, joint notation schemes, work volume, introduction to manipulator kinematics, position representation, forward and reverse transformations of a 2- DOF arm, a 3- DOF arm in two dimension , a 4 – DOF arm in three dimension, homogeneous transformations in robot kinematics, D-H notations, solving kinematics equations, introduction to robot arm dynamics.	7	15%
II	Basic control system models, slew motion, joint – interpolated motion and straight line motion, controllers like on/off, proportional, integral, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative.	7	15%

FIRST INTERNAL EXAMINATION			
III	Robot actuation and feedback components position and velocity sensors, actuators and power transmission devices, mechanical grippers , vacuum cups, magnetic grippers, pneumatic, electric , hydraulic and mechanical methods of power and control signals to end effectors.	7	15%
IV	General considerations in robot material handling, material transfer applications, pick and place operations, palletizing and related operations, machine loading and unloading, die casting, plastic molding, forging, machining operations, stamping press operations using robots.	7	15%
SECOND INTERNAL EXAMINATION			
V	Robot Programming and AI: Methods - Languages - Computer control and Robot Software -VAL Language – Trajectory Planning, Basic robot motions - Point to point control & continuous path control and interpolations AI – Basics – Goals-AI Techniques – AI & Robotics.	7	20%
VI	Robot cell layouts , multiple robots and machine interface, other considerations in work cell design, work cell control, interlocks, error detection and recovery, work cell controller, robot cycle time analysis.	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course name	L-T-P-Credits	Year of Introduction
AE468	NANO ELECTRONICS	3-0-0-3	2016

Course objectives

- To impart the basic concepts of nanotechnology
- To develop understanding about application of nanomaterials.

Syllabus

Introduction to nanotechnology and Nano electronics- fabrication of nano materials- Introduction to characterization tools of nano materials- basic properties of 2d semiconductor nanostructures- The concept of super lattices Kronig - Penney model of super lattice- Nanoelectonic devices and systems- Nanocomposites- nanofillers

Expected outcome

- At the end of the semester students will have good idea regarding nano electronics and their various applications.

Text books

1. J.M. Martinez-Duart,R.J. Martin Palma,F. Agulle Rueda "*Nanotechnology for Microelectronics and optoelectronics*" , Elsevier, 2006.
2. W.R. Fahrner,"*Nanotechnology and Nanoelctronics*", Springer, 2005

Reference books

1. Chattopadhyay,Banerjee, "*Introduction to Nanoscience & Technology*",PHI 2009
2. Diwanand and Bharadwaj,"*Nanoelectronics*",Pentagon Press Delhi 2006
3. Goser, P. Glosekotter, J. Dienstuhl, "*Nanoelectronics and nanosystems*", Springer 2004.
4. Poole*, "Introduction to Nanotechnology* ",John Wiley 2006
5. Pulikel M. Ajayan,"*Nanocomposite science and technology*", Wiley-VCH 2005
6. Supriyo Dutta, "*Quantum Transport- Atom to transistor*", Cambridge University Press, 2005.
7. T. Pradeep, "*Nano the Essentials*", TMH, 2007.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction to nanotechnology and Nano electronics, Impacts, Limitations of conventional microelectronics. Introduction to methods of fabrication of nano materials- different approaches. fabrication of nano-layers -Physical Vapor Deposition, Chemical Vapor Deposition, Epitaxy, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide. Fabrication of nanoparticle- grinding with iron balls, laser ablation, reduction methods, sol gel, self-assembly.	7	15%
II	Introduction to characterization tools of nano materials- - principle of operation of STM, AFM, SEM, TEM, XRD, PL & UV instruments. Mesoscopic Physics and Nanotechnologies - trends in Microelectronics and Optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Quantum wells,wires and dots, Density of states and dimensionality .	6	15%
FIRST INTERNAL EXAMINATION			
III	The physics of low dimensional structures - basic properties	7	15%

	of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells, quantum wires and quantum dots. Semiconductor quantum nanostructures and super lattices – MOSFET structures, Heterojunctions, Quantum wells, modulation doped quantum wells, multiple quantum wells.		
IV	The concept of super lattices Kronig - Penney model of super lattice. Transport of charge in Nanostructures under Electric field - parallel transport, perpendicular transport, quantum transport in nanostructures. Transport of charge in magnetic field and quantum Hall effect - Effect of magnetic field on a crystal, the Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect.	7	15%
SECOND INTERNAL EXAMINATION			
V	Nanoelectonic devices and systems - MODFETS, heterojunction bipolar transistors, resonant tunnel effect, RTD, RTT,hot electron transistors, Coulomb blockade effect and single electron transistor, CNT transistors, heterostructure semiconductor laser, quantum well laser, quantum dot LED, quantum dot laser, vertical cavity surface emitting laser, quantum well optical modulator, quantum well sub band photo detectors, Infrared detector, Nano switches, principle of NEMS..	8	20%
VI	Nanocomposites, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Smart materials, self-assembly of materials, safety issues with nanoscale powders.	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course name	L-T-P-Credits	Year of Introduction
AE472	PETROLEUM ENGINEERING	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To impart the basic concepts of petroleum production, testing etc.
- To impart idea on Health Safety and Environment in Petroleum Industry.
- To update with the latest trends in Petroleum Engineering.

Syllabus

Refinery products - Coking and thermal process - Catalytic Cracking - Coring and core analysis - Reservoir fluid properties - Reserve estimation & techniques - Well equipments - Well servicing & Workover operations - Field processing of oil & gas - Production system analysis & optimization - Nodal system analysis - LNG value chain - Lubricating oil blending stocks petrochemical feedstocks - Evaluation of CBL/VDL, USIT, SFT, RFT. - Production logging tools, principles, limitations and applications. - Cost Evaluation - Latest trends in Petroleum Engineering.

Expected outcome

At the end of the semester students will be able

i. To gain advanced knowledge in petroleum engineering
ii. To get knowledge in industrial safety and cost evaluation

Text Books

1. A.Lucas Hurley , Modern Petroleum Technology Upstream Vol I Edition 2002.
2. A.G. Lucas Hurley , Modern Petroleum Technology Downstream Vol II Edition 2002.
3. J.CH Garry , Hardward G.E and M.J.Kaiser, Petroleum Refining : Technology and economics CRC Press V Edition

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Refinery products – Refinery Feeds – Crude distillation – Coking and thermal process : Classification and description of some common rocks with special reference to clastic and nonclastic reservoir rocks. Origin, migration and accumulation of Petroleum. Petroleum exploration methods.	6	15%
II	Catalytic Cracking - Catalytical hydro cracking – Hydro processing and Reused processing hydro treating. Petrophysical properties of reservoir rocks. Coring and core analysis. Reservoir fluid properties. Phase behavior of hydrocarbon system. Flow of fluids through porous media. Water and gas coning.	6	15%
FIRST INTERNAL EXAMINATION			
III	Well equipments. Well completion techniques. Well production problems and mitigation. Well servicing & Workover operations. Workover & completion fluids. Formation damage. Well stimulation techniques. Artificial lift techniques. Field processing of oil & gas. Storage and transportation of petroleum and petroleum products. Metering and measurements oil & gas.	7	15%

IV	Production system analysis & optimization. Production testing. Multiphase flow in tubing and flow-lines. Nodal system analysis. Pressure vessels, storage tanks, shell and tube heat exchangers, pumps and compressors, LNG value chain.	7	15%
SECOND INTERNAL EXAMINATION			
V	Lubricating oil blending stocks petrochemical feedstocks. Evaluation of petro physical of sub-surface formations: Principles applications, advantages and disadvantages of SP, resistivity, radioactive, acoustic logs and types of tools used. Evaluation of CBL/VDL, USIT, SFT, RFT. Production logging tools, principles, limitations and applications.	8	20%
VI	Special type of logging tools. Casing inspection tools (principles, applications and limitations), Formations micro scanner (FMS), NMR logging principles. Standard log interpretation methods. Cross-plotting methods. Cost Evaluation – Economic evaluation of petroleum reused and refineries. Latest trends in Petroleum Engineering: Coal bed methane, shale gas, oil shale, gas hydrate, and heavy oil.	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course Name	Credits	Year of Introduction
**492	PROJECT	6	2016

Prerequisite : Nil

Course Objectives

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Course Plan

In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester
Review and finalization of the approach to the problem relating to the assigned topic
Preparing a detailed action plan for conducting the investigation, including team work
Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
Final development of product/process, testing, results, conclusions and future directions
Preparing a paper for Conference presentation/Publication in Journals, if possible
Preparing a report in the standard format for being evaluated by the dept. assessment board
Final project presentation and viva voce by the assessment board including external expert

Expected outcome

The students will be able to

iii. Think innovatively on the development of components, products, processes or technologies in the engineering field
iv. Apply knowledge gained in solving real life engineering problems

Evaluation

Maximum Marks : 100

(i) Two progress assessments	20% by the faculty supervisor(s)
(ii) Final project report	30% by the assessment board
(iii) Project presentation and viva voce	50% by the assessment board

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.