Course No.	Course name	L-T-P-Credits	Year Of Introduction
AE202	COMPUTER PROGRAMMING	2-2-0-4	2016

Course objectives

This course provides students with an entry level foundation in computer programming in C and Python . Also enables students to apply these programming skills in their field of study.

Syllabus: Basics of c programming, control statements, arrays and strings, functions, user defined data types: structure, union, enumerated data type, pointers and files.
Introduction to Python, comparisons of Python constructs with C.

Expected outcome

To write program in c for various engineering, science and technology related problems.
To familiarise python language by comparison with C language.
Enable students to write simple programs in python and also enable them to ponder more into python language.

Text Books

1. Kelley, Al & Pohl, Ira. A Book on Computer Programming in C, 4th Ed,, Pearson Education
2. Lambert K. A., Fundamentals of Python - First Programs, Cengage Learning India, 2015

Reference

1. Balagurusamy E., Programming in ANSI C, Tata McGraw Hill
2. Samarjit Ghosh, All of C, PHI Learning
3.Barry, P., Head First Python, , O' Reilly Publishers
4. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India
5 Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming in C, Oxford.
6. Ashok N Kamthane ; Programming in C
7.Downey, A. et al., How to think like a Computer Scientist: Learning with Python, John Wiley, 2015
8. www.python .org
9. www.tutorialpoints.com

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Programming basics: Flowcharts and Algorithms. Compiler– Interpreter-Linker-Loader. **Structured programming** Introduction to C: Character set, Identifiers, Keywords, Constants –Data Types- Variables – Operators and Expressions – Operator precedence and associativity – Expression Evaluation (Simple Examples) – Simple computational problems involving the above constructs .	9	15%
II	Control Statements: Selection, Iteration (for, while, do-while), Branching (switch, break, continue, goto), Nesting of control statements- simple programs using control statements.	8	15%
FIRST INTERNAL EXAMINATION			

III	Arrays and Strings: 1D and 2D arrays –Searching (Linear and binary) - Sorting (Bubble, Selection) – Matrix manipulation programs – Strings and basic operations on strings – String functions – Basic Programs on string manipulation. Functions: Definition – Calling – Declaration – Parameter Passing (by value and by reference) – Recursion – Library functions –Basic Programs based on functions.	11	20%
IV	User defined data types: Structure – Union - Enumerated data type - Programs involving structure and union. Pointers: Declaration, Initialization – Pointers and arrays – Pointers and structures – Pointers and functions – Command line arguments – Dynamic memory allocation – Operations on pointers – Basic Programs involving the above concepts Files: file operations	10	20%
SECOND INTERNAL EXAMINATION			
V	**<u>Object oriented programming</u>** Introduction to Python : Comparison of following Python constructs with C- keywords, variables, operators, expression and statements, control statements- programming examples	9	15%
VI	Comparison of constructs of python with C - Functions, calling functions, user defined functions, strings and lists-programming examples Basics of Tuples, Dictionary and Exception handling in python.	9	15%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum marks : 100 Time : 3 hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2. 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. Each question carries 15 marks and may have not more than four (15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6. Each question carries 20 marks and may have not more than four sub divisions. (20 x 2 = 40 marks)

Course No.	Course Name	L-T-P - Credits	Year of Introduction
AE204	SENSORS AND TRANSDUCERS	3-0-0-3	2016

Prerequisite:

Course Objectives

• To give ideas on various types of Sensors & Transducers and their working principle
• To understand Resistive, Capacitive and Inductive transducers
• To enable the students to select and design suitable instruments to meet the requirements of industrial applications

Syllabus

Definition of transducers– Classification of transducers – Resistance transducer- Capacitance transducer Motion Transducers – Sound transducers- Pressure Transducers - Hall effect transducers – Piezo electric sensors - Fiber optic sensor- Semiconductor sensor – Basics of seismic instrument- Flow Transducers

Expected outcome .

The students will be able to

- apply working principles of sensors and transducers while doing projects in instrumentation.
- differentiate between the types of transducers available
- gain information about the function of various measuring instruments and sensors and their uses

Text Book:

1. John P. Bentley, “Principles of Measurement Systems”, 3rd Edition, Pearson Education,
2. S.M. Sze, “Semiconductor sensors”, John Wiley & Sons Inc., Singapore, 1994.
4. S. Renganathan “Transducer Engineering”, Allied publishers Limited, Chennai, 2003.

Data Book (Approved for use in the examination):

References:

1. Murthy D. V. S, “Transducers and Instrumentation”, Prentice Hall, New Delhi, 1995.
2. Neubert H.K.P, “Instrument Transducers - An Introduction to their Performance and Design”, 2nd Edition, Oxford University Press, Cambridge, 1999.
3. Patranabis, “Sensors and Transducers”, 2nd Edition, Prentice Hall India Pvt. Ltd., 2003.
4. Waldemar Nawrocki, “Measurement Systems and Sensors”, Artech House, 2005.
5. Doebelin E.O, “Measurement Systems - Application and Design”, 4th Edition, McGraw-Hill, New York, 2003.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Transducers: Definition of transducers, classification based on transduction principle, measurand, material and technology, Analog and digital transducers, Active and passive transducers, Primary and Secondary transducers. Characteristics of transducers.	6	15%
II	Resistance Transducer : Basic principle – Potentiometer – Loading effects, Resolution, Linearity, Resistance strain gauge –Types.	6	15%

	Inductance Transducer :- Basic principle – Linear variable differential transformer – RVDT-types. Capacitance Transducer : Basic principle- transducers using change in area of plates – distance between plates- variation of dielectric constants-frequency response –Types		
FIRST INTERNAL EXAMINATION			
III	Force and Torque Transducers: Proving ring, hydraulic and pneumatic load cell, dynamometer and gyroscopes. Sound Transducers: Sound level meter, sound characteristics, Microphone. Torque transducer design-the torque measurement system-the rotation rate measurement system	7	15%
IV	Pressure Transducers: basic principle- different types of manometers-u tube manometer-well type manometers. Level transducer-continuous level measurement-discrete level measurement-mass –capacitive level gauges, Dead weight calibrator .	7	15%
SECOND INTERNAL EXAMINATION			
V	Hall effect transducers, Digital transducers, Proximity devices, , Piezo-electric sensors, eddy current transducers, tachogenerators and stroboscope, Magnetostrictive transducers, Fibre optic sensor, Semiconductor sensor. Basics of Seismic instrument and accelerometers	8	20%
VI	Flow Transducers: Bernoulli's principle and continuity, orifice plate, nozzle plate, venture tube, Rota meter, anemometers, electromagnetic flow meter, impeller meter and turbid flow meter	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum marks : 100 Time : 3 hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2. 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. Each question carries 15 marks and may have not more than four (15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6. Each question carries 20 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
AE232	TRANSDUCERS AND INSTRUMENTATION LAB	0-0-3-1	2016

Prerequisite : AE204 Sensors and transducers

Course objective

- To give a hands on experience to students in various transducers and instrumentation.

Experiments :- (Minimum 12 experiments are mandatory)

1. Determination of the characteristics of LVDT.
2. Determination of characteristics of temperature sensor (AD590).
3. Determination of the characteristics of thermocouple.
4. Determination of the characteristics of RTD
5. Determination of the characteristics of optical transducers using LDR.
6. Determination of the characteristics of capacitive displacement transducer.
7. Measurement of displacement using inductive transducer.
8. Calibration of force transducer signal conditioner plot force/voltage characteristics curve.
9. Measurement of torque and pressure using strain gauges.
10. Determination of the characteristics of Micro pressure and Micro accelerometer sensing device.
11. Measurement of pressure using piezoelectric pick up.
12. Measurement of strain and load using strain gauges.
13. Determination of the characteristics of Hall Effect sensor.
14. Calibration using dead weight tester.
15. Level measurement using capacitive transducer.
16. Pressure measurement using U-tube manometer.
17. Measurement of speed using photo electric pickup transducers.
18. Measurement of position using synchro Transmitter and receiver.

Expected outcome

- At the end of the semester students are expected to be familiar with various transducers and its application.

Course code	Course name	L-T-P-Credits	Year of Introduction
AE301	CONTROL SYSTEM	3-1-0-4	2016

PREREQUISITE : Nil

Course objectives

- To familiarize the modelling of linear time invariant systems and their responses in time and frequency domain.
- To learn state space techniques

Syllabus

Mathematical model of systems – transfer function – block diagram -System analysis-time domain analysis- stability of linear systems -frequency domain analysis- state variable analysis –state diagram.

Expected outcome

At the end of the semester students will be able to understand and analyse the different behaviour of system performances.

Text Books

1. I J Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers, New Delhi,1997
2. M. Gopal, Digital Control and State Variable Methods, 2 nd ed., Tata McGraw Hill, New Delhi, 2003

Reference Books

1. G. J. Thaler, Automatic Control Systems, Jaico Publishing House, Mumbai, 2005
2. K. Ogata, Modern Control Engineering, 4th ed., Pearson Education, Delhi, 2002
3. B. C. Kuo, Automatic Control Systems, 7th ed., Prentice Hall of India, New Delhi, 1995
4. R. C. Dorf and R. H. Bishop, Modern Control Systems, 10th ed., Pearson Education, Delhi, 2004

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	System Analysis: Systems, subsystems, and stochastic and deterministic systems - Principles of automatic control -Open loop and closed loop systems -Principles of superposition and homogeneity-Transfer Function Approach: Mathematical models of physical systems and transfer function approach - Impulse response and transfer function -Determination of transfer functions for simple electrical, mechanical, electromechanical, hydraulic and pneumatic systems - Analogous systems -Multiple-input multiple-output systems: Block diagram algebra - block diagram reduction -Signal flow graphs -Mason's gain formula.	8	15%
II	Time Domain Analysis: Standard test signals -Response of systems to standard test signals –Step response of second order systems -Time domain specifications (of second order system) -Steady state response -Steady state error -Static and dynamic error coefficients -Zero input and zero state response	8	15%
	FIRST INTERNAL EXAMINATION		
III	Stability of linear systems -absolute stability -relative stability	8	15%

	-Hurwitz and Routh stability criterion -Root locus method -construction of root locus -root contours -root sensitivity to gain k -effect of poles and zeros and their locations on the root locus.		
IV	Frequency Domain Analysis: Frequency response representation -Frequency domain specifications -Correlation between time and frequency response -Polar plots -Logarithmic plots -Bode plots – All pass, minimum-phase and non-minimum-phase systems -Transportation lag -Stability in frequency domain -Nyquist stability criterion -Stability from polar and bode plot -Gain margin and phase margin -relative stability -M-N circles -Nichols chart.	9	15%
SECOND INTERNAL EXAMINATION			
V	State Variable Analysis: Concepts of state, state variables, state vector and state space -State model of continuous time systems Transformation of state variable -Derivation of transfer function from state model -invariance property	9	20%
VI	State diagram -State variable from transfer function -bush or companion form -controllable canonical form - observable canonical form -Jordan canonical form -Diagonalization-State transition matrix -computation of state transition matrix by Laplace transform, Cayley-Hamilton theorem -Controllability and observability of a system. (proof not required)	10	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
AE302	PROCESS CONTROL	4-0-0-4	2016

Prerequisite : Nil

Course objectives

- To introduce the principles of various control and instrumentation components and strategies applied in a process control system.
- To Basics of Principals of Sensors and Transducers, Control System Component and Process Loop Control

Syllabus

Process characteristics - Types of processes- Analysis of Control Loop- Analysis of Flow Control- Feedback Control- Multi Loop & Nonlinear Systems-Concept of Multivariable Control- Intelligent Controllers

Expected outcome

- At the end of the semester students will be able to understand and analyse the different behaviour of process control system performances.

Text Books

1. B.Wayne Bequette, *Process Control: Modeling, Design and Simulation,* PHI
2. Donald Eckman – *Automatic Process Control*, Wiley Eastern Limited
3. F.G.Shinskey, *Process control Systems* ,TMH

Reference Books

1. B.G.Liptak ,*Handbook of Instrumentation -Process control* ,Chilton
2. Considine, *Process Instrumentation and control Handbook* , 5th Ed., McGraw Hill
3. Krishna Kant, *Computer Based Industrial Control* ,PHI
4. Murrill ,*Applications concepts of Process control*, ISA
5. Murrill, *Fundamentals of Process Control* , ISA
6. Stephanopoulos George ,*Chemical Process Control*, PHI
7. T.J.Ross *Fuzzy Logic with Engineering Applications*, John Wiley & Sons, 2004
8. Thomas E Marlin - *Process Control- Designing processes and Control Systems for Dynamic performance,* McGraw-Hill International Editions

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Process characteristics: Incentives for process control, Process Variables types and selection criteria,, Process degree of freedom, The period of Oscillation and Damping, Characteristics of physical System: Resistance, Capacitive and Combination of both. Elements of Process Dynamics, Types of processes- Dead time, Single /multi capacity, self-Regulating /non self-regulating, Interacting /non interacting, Linear/non-linear, and Selection of control action for them. Study of Liquid Processes, Gas Processes, Flow Processes, Thermal Processes in respect to above concepts	9	15%
II	Analysis of Control Loop: Steady state gain, Process gain, Valve gain, Process time constant, Variable time Constant, Transmitter gain, Linearizing an equal percentage valve, Variable pressure drop. Analysis of Flow Control, Pressure Control, Liquid level Control, Temperature control, SLPC-	8	15%

	features, faceplate, functions, MLPC- features, faceplate, functions, SLPC and MLPC comparison. Scaling: types of scaling, examples of scaling		
FIRST INTERNAL EXAMINATION			
III	Feedback Control: Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control Approach to Process Control. Factors in Controller Tuning, Determining Tuning Constants for Good Control Performance, Correlations for tuning Constants, Fine Tuning of the controller tuning Constants.	8	15%
IV	Multi Loop & Nonlinear Systems: Cascade control, Feed forward control, feedback-feed forward control, Ratio control, Selective Control , Split range control- Basic principles, Design Criteria , Performance, Controller Algorithm and Tuning, Implementation issues, Examples and any special features of the individual loop and industrial applications. Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance.	9	15%
SECOND INTERNAL EXAMINATION			
V	Multivariable Control: Concept of Multivariable Control: Interactions and its effects, Modelling and transfer functions, Influence of Interaction o the possibility of feedback control, important effects on Multivariable system behaviour Relative Gain Array, effect of Interaction on stability and tuning of Multi Loop Control system. Multi Loop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.	10	20%
VI	Intelligent Controllers: Step analysis method for finding first, second and multiple time constants and dead time. Model Based controllers: Internal Model control, Smith predictor, optimal controller, Model Predictive controller, Dynamic matrix controller (DMC). Self Tuning Controller. Fuzzy logic systems and Fuzzy controllers, Introduction, Basic Concepts of Fuzzy Logic, Fuzzy Sets, Fuzzy Relation, Fuzzy Graphs, and Fuzzy Arithmetic, Fuzzy If-Then Rules, Fuzzy Logic Applications, Neuro-Fuzzy Artificial Neural networks and ANN controller.	10	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
AE303	ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS	3-0-0-3	2016

Prerequisite: Nil

Course objectives

- To impart knowledge on different types of measuring techniques using electrical and electronic measurement system.

Syllabus

General Principles of Measurements- Calibration of Meters- Errors in Measurement and its Analysis- Essentials of indicating instruments- Moving Iron, Dynamo Meter- D.C bridges- A.C bridges-Series and shunt type ohm meter- Electronic measurements- Analog and digital multimeters- Waveform analyzing instruments: Distortion meter- Spectrum analyser- Magnetic Measurements- Data Acquisition systems.

Expected outcome

The students will be able

i. To learn the use of different types of analogue meters for measuring electrical quantities such as current, voltage, power energy power factor and frequency.
ii. To learn the principle of working and applications of electronic measuring devices.

Text Books

1. Baldwin, C.T., "Fundamentals of electrical measurements" – Lyall Book Depot, New Delhi, 1973.
2. David.A.Bell, "Electronic Instrumentation and Measurements", 2nd Edition, Prentice Hall, New Jersy, 1994.
3. Golding, E.W. and Widdis, F.C., "Electrical Measurements and Measuring Instruments" A.H.Wheeler and Co, 5th Edition, 1993.

Reference Books

1. Cooper, W.D. and Helfric, A.D., "Electronic Instrumentation and Measurement Techniques" Prentice Hall of India, 1991.
2. Kalsi.H.S., "Electronic Instrumentation", Tata McGraw Hill, New Delhi, 1995
3. Pattanabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd., 2003.
4. Waldemar Nawrocki, "Measurement Systems and Sensors", Artech House, 2005

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	General Principles of Measurements: Absolute and Working Standards- Calibration of Meters- Qualities of Measurements- Accuracy, precision, sensitivity, resolution, loading effect. - Characteristics - Errors in Measurement and its Analysis	6	15%
II	Essentials of indicating instruments- deflecting, damping, controlling torques- Moving Coil , Moving Iron, Dynamo Meter, Induction, Thermal, Electrostatic and Rectifier Type meter; Shunts and Multipliers-Various Types of Galvanometers- Accuracy class.	7	15%
FIRST INTERNAL EXAMINATION			
III	DC Bridges: Introduction, sources & detectors for DC bridge,	7	15%

	general equation for bridge at balance. Wheatstone and Kelvin's double bridge, Carry Foster Slide Wire Bridge – Bridge Current Limitations.		
IV	AC bridges: Introduction, sources & detectors for a.c bridge, general equation for bridge at balance. Maxwell's Inductance & Maxwell's Inductance-Capacitance Bridge, Anderson bridge, Measurements of capacitance using Schering Bridge. Potentiometers: General principle, Modern forms of dc potentiometers, standardization, Vernier dial principle, AC potentiometers – coordinate and polar types, application of dc and ac potentiometers	8	15%
SECOND INTERNAL EXAMINATION			
V	Cathode ray oscilloscope (review), Special purpose oscilloscopes- delayed time base, analog storage, sampling oscilloscopes. Digital storage oscilloscopes-DSO applications. Method of measuring voltage, current, phase, frequency and period using CRO, DSO. Graphic Recording Instruments: strip chart recorder, X-Y recorder, Plotter, liquid crystal display (LCD).	7	20%
VI	Waveform analysing instruments: Distortion meter, Spectrum analyser, Digital spectrum analyser, Q meter, Watthour meter, Power-factor meter, Instrument transformers, Thermocouple instruments, Peak response voltmeter, True RMS meter	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
AE304	INDUSTRIAL INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To equip the students with the basic knowledge of Pressure, Temperature, flow, level, Density and viscosity measurements.
- To understand the construction and working of measuring instruments

Syllabus

Temperature measurement- Pressure measurement- Measurement of viscosity- Flow measurement- Anemometers- Target flow meters- Level measurement

Expected outcome

The students will be able to

i. grasp the working of different types of instruments for measurement of mechanical quantities

ii. choose appropriate instruments for measurement of mechanical quantities

Text Books

1. Doebelin E.O, "*Measurement Systems: Application and Design*", 4th Edition, McGraw Hill, New York, 2003.
2. Patranabis D, "*Principles of Industrial Instrumentation*", 2ndEdition, Tata McGraw Hill, New Delhi, 1997.
3. Spitzer D. W., *Flow measurement*, ISA press, New York, 1998

Reference Books

1. Andrew W.G, "*Applied Instrumentation in Process Industries – A survey*", Vol I & Vol II, Gulf Publishing Company, Houston, 2001.
2. Douglas M. Considine, "*Process / Industrial Instruments & Controls Handbook*", 5th Edition, McGraw Hill, Singapore, 1999.
3. Liptak B.G, "*Process Measurement and Analysis*", 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
4. Noltingk B.E., *"Instrumentation Reference Book"*, 2ndEdition, Butterworth Heinemann, 1995.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Temperature measurement: Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. Thermistors, principle and sensor types, manufacturing techniques, measuring circuits, linearization methods and applications. Pneumatic and suction pyrometers, integrated circuit sensors, diode type sensors, ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats.	7	15%
II	Pressure measurement basics, mechanical type instruments, electromechanical type, low pressure measurement, related accessories, pressure measuring standards, selection and application. Transmitter definition, classification, pneumatic	7	15%

	transmitter-force balance type, torque balance type, two wire and four wire transmitters, I/P and P/I converters.		
FIRST INTERNAL EXAMINATION			
III	Measurement of viscosity: definitions, units, Newtonian and Newtonian behaviour, measurement of viscosity using laboratory viscometers, industrial viscometers. Viscometer selection and application. Measurement of density, definitions, units, liquid density measurement, gas densitometers, its application and selection.	7	15%
IV	Flow measurement: Introduction, definitions and units, classification of flow meters, pitot tubes, positive displacement liquid meters and provers, positive displacement gas flow meters, variable area flow meters.	6	15%
SECOND INTERNAL EXAMINATION			
V	Anemometers: Hot wire/hot film anemometer, laser Doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters. Measurement of mass flow rate: radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine Coriolis, gyroscopic and heat transfer type mass flow meters. Target flow meters: V-cone flow meters purge flow regulators, flow switches, flow meter calibration concepts, flow meter selection and application.	8	20%
VI	Level measurement: introduction, float level devices, displacer level devices, rotating paddle switches, diaphragm and deferential pressure detectors, resistance, capacitance and RF probes, radiation, conductivity, field effect, thermal, ultrasonic, microwave level switches, radar and vibrating type level sensors. Level sensor selection and application.	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
AE305	MICROPROCESSORS & MICROCONTROLLERS	3-0-0-3	2016

Prerequisite: Nil

Course Objective

- To expose the features of advanced microprocessors like 8086, 80386, and Pentium processors
- To introduce the architecture, programming, and interfacing of the microcontroller 8051

Syllabus

Intel 8086 - Assembler directives and operators - 8086 hardware design - Multi-processor configuration - Memory (RAM and ROM) interfacing - 8087 co-processor architecture and configuration - Introduction to 80386 - Superscalar architecture - 8051 Microcontroller - Assembly Language programming in 8051.

Expected outcome

At the end of the semester students will be

i. familiar with microprocessors and microcontrollers
ii. able to study the processor architecture, assembly language, memory management, interfacing etc.

Text Books

1. A K Ray and K M Bhurchandi, , Advanced Microprocessors and Peripherals, Tata McGraw Hill, 2006
2. D V Hall, Microprocessors and Interfacing: Programming and Hardware, 2nd ed., Tata McGraw Hill, 1999.
3. M A Mazidi and J. G. Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, Delhi, 2004
4. Ramani Kalpathi and Ganesh Raja, Microcontrollers and Applications, Pearson Education, 2010

Reference Books

1. B Brey, The Intel Microprocessors, 8086/8088, 80186, 80286, 80386 and 80486 architecture, Programming and interfacing, 6th ed., Prentice Hall of India, New Delhi, 2003
2. K J Ayala, The 8051 Microcontroller- Architecture, Programming and applications, Thomson Delmar Publishers Inc., India reprint Penram
3. Y C Liu and G A Gibson, Microcomputer system: The 8086/8088 family, 2nd ed., Prentice Hall of India, New Delhi, 1986

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Intel 8086, format:, Assembler directives and operators, Assembly process, Linking and relocation, stacks, procedures, interrupt routines, macros.	7	15%
II	8086 hardware design - Bus structure, bus buffering and latching, system bus timing with diagram, Minimum and maximum mode configurations of 8086, Multi-processor configuration, 8087 co-processor architecture and configuration, Memory (RAM and ROM) interfacing, memory	8	15%

	address decoding.		
FIRST INTERNAL EXAMINATION			
III	8087 co-processor architecture and configuration, Memory (RAM and ROM) interfacing, memory address decoding	6	15%
IV	Introduction to 80386 – Memory management unit – Descriptors, selectors, description tables and TSS – Real and protected mode – Memory paging – Pentium processor -Special features of the Pentium processor – Branch prediction logic– Superscalar architecture, microprocessors - state of the art	7	15%
SECOND INTERNAL EXAMINATION			
V	8051 Microcontroller: Overview of 8051 family, architecture of 8051, Program counter, ROM space in 8051, data types and directives, flags and PSW register, register bank and stack, Addressing modes. Instruction set Arithmetic instructions JUMP, LOOP,CALL instructions, time delay generations.	7	20%
VI	Assembly Language programming in 8051 (some simple programs): programs using arithmetic and logic instructions, single bit instructions and programs, Timer/counter programming, 8051 serial communication programming, programming timer interrupts. Interfacing with Stepper motor, keyboard, DAC, external memory.	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
AE306	Digital Signal Processing	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To introduce the basic concepts and techniques for processing signals on a Computer.

Syllabus

Discrete-time and digital signals- DFT and the FFT- Z-transform- FIR Filters- IIR Filters- Filter Realization- Computer architectures for signal processing.

Expected outcome

- The students will be familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors.

Text Books

1. Chen, C.T., "*Digital Signal Processing: Spectral Computation & Filter Design*", Oxford Univ. Press, 2001
2. Ifeachor, E.C., & Jervis, B.W., *"Digital Signal Processing: A Practical Approach*", 2/e, Pearson Education Asia, 2002.
3. Proakis, J.G. & Manolakis, D.G., "*Digital Signal Processing: Principles, Algorithms, & Applications*", 3/e Prentice Hall of India, 1996.

Reference Books:

1. Embree, P.M., & Danieli, D., *"C++ Algorithms for Digital Signal Processing*", 2/e, Prentice Hall Upper Saddle River, NJ, 1999.
2. McClellan, J.H., Schafer, R.W., & Yoder, M.A., *"DSP First: A Multimedia Approach*", Prentice Hall Upper Saddle River, NJ, 1998
3. Mitra, S.K., "*Digital Signal Processing: A Computer-Based Approach*", McGraw Hill, NY, 1998

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Signal Processing Fundamentals: Discrete-time and digital signals, A/D, D/A conversion and Nyquist rate, Frequency aliasing due to sampling, Need for anti-aliasing filters. Discrete Time Fourier transform and frequency spectra, Spectral computation, Computational complexity of the DFT and the FFT, Algorithmic development and computational advantages of the FFT, Inverse FFT, Implementation of the FFT, Correlation of discrete-time signals.	7	15%
II	Discrete-time systems, Difference equations and the Z-transform, Analysis of discrete-time LTIL systems, Stability and Jury's test.	6	15%
	FIRST INTERNAL EXAMINATION		
III	FIR Filters: Ideal digital filters, Realizability and filter specifications, Classification of linear phase FIR filters, Design using direct truncation, window methods and frequency sampling, Least-squares optimal FIR filters,	7	15%

	Minimax optimal FIR filters, Design of digital differentiators and Hilbert transformers, comparison of design methods.		
IV	IIR Filters: Design of analogue prototype filters, Analog frequency transformations, Impulse invariance method and digital frequency transformations, Bilinear transformation, Analog prototype to digital transformations, Difficulties in direct IIR filter design, Comparisons with FIR filters.	7	15%
SECOND INTERNAL EXAMINATION			
V	Filter Realization: Structures for FIR filters, Structures for IIR filters, State-space analysis and filter structures, Fixed point and floating-point representation of numbers, Errors resulting from rounding and truncating, Quantization effects of filter coefficients, Round-off effects of digital filters.	7	20%
VI	DSP Processors: Computer architectures for signal processing – Harvard architecture and pipelining, General purpose digital signal processors, Selection of DSPs, Implementation of DSP algorithms on a general purpose DSP, Special purpose hardware – hardware digital filters and hardware FFT processors, Evaluation boards for real-time DSP.	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
AE307	SIGNALS AND SYSTEMS	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To impart the basic concepts of continuous and discrete signals and systems
- To develop understanding about frequency domain approaches used for analysis of continuous and discrete time signals and systems.
- To establish the importance of z-transform and its properties for analyzing discrete time signals and systems

Syllabus

Introduction to signals and systems - Classification of signals - Properties of systems - Representation of LTI systems - Continuous & Discrete Time LTI systems - Frequency response of LTI - Continuous Time Fourier Series - Discrete Time Fourier Transform - Laplace Transform – Causality and stability- Z Transform- Determining the frequency response from poles and zeros.

Expected outcome

The students are expected to:

i. Have an advanced knowledge in continuous and discrete signals and systems
ii. Have knowledge in z-transform

Text Books

1. Haykin S. & Veen B.V., *Signals & Systems*, John Wiley
2. Oppenheim A.V., Willsky A.S. & Nawab S.H., *Signals and Systems*, Tata McGraw Hill
3. Taylor F.H., *Principles of Signals & Systems*, McGraw Hill

References

1. Bracewell R.N., *Fourier Transform & Its Applications*, McGraw Hill
2. Haykin S., *Communication Systems*, John Wiley
3. Lathi B.P., *Modern Digital & Analog Communication Systems*, Oxford University Press
4. Papoulis A., *Fourier Integral & Its Applications*, McGraw Hill

Course Plan

Module	Contents	Hours	Semester exam marks
I	Introduction to signals and systems - Classification of signals - Basic operations on signals – Elementary signals - Concept of system - Properties of systems - Stability, invertability, time invariance - Linearity - Causality - Memory - Time domain description - Convolution - Impulse response.	7	15%
II	Representation of LTI systems - Differential equation and difference equation representations of LTI systems ,Continuous Time LTI systems and Convolution Integral, Discrete Time LTI systems and linear convolution.	6	15%
FIRST INTERNAL EXAMINATION			

III	Frequency response of LTI systems - Correlation theory of deterministic signals - Condition for distortionless transmission through an LTI system - Transmission of a rectangular pulse through an ideal low pass filter - Hilbert transform – Sampling and reconstruction	8	15%
IV	Frequency Domain Representation of Continuous Time Signals- Continuous Time Fourier Series: Convergence. Continuous Time Fourier Transform: Properties. Frequency Domain Representation of Discrete Time Signals- Discrete Time Fourier Transform: Properties, Sampling Theorem, aliasing, reconstruction filter, sampling of band pass signals. Fourier Series Representation of Discrete Time Periodic Signals.	7	15%
SECOND INTERNAL EXAMINATION			
V	Laplace Transform – ROC – Inverse transform – properties – Analysis of Continuous LTI systems using Laplace Transform – unilateral Laplace Transform. Relation between Fourier and Laplace Transforms. Laplace transform analysis of systems - Relation between the transfer function and differential equation - Causality and stability - Inverse system - Determining the frequency response from poles and zeros	7	20%
VI	Z Transform - Definition - Properties of the region of convergence - Properties of the Z transform - Analysis of LTI systems - Relating the transfer function and difference equation - Stability and causality - Inverse systems - Determining the frequency response from poles and zeros	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
AE308	ADVANCED MICROPROCESSORS	3-0-0-3	2016

Prerequisite: AE305 Microprocessors & microcontrollers

Course Objective

- To familiarise the importance and applications of advance microprocessor
- To understand architecture of ARM processor
- To understand instruction set of ARM processor

Syllabus

Need of advance microprocessors- RISC and CISC- ARM Architecture and Programmers Model- ARM Instruction set- C Programming for ARM- Memory management units- Advanced Microprocessor Bus Architecture.

Expected outcome

- The students will have good idea about ARM processor and its application.

Text Books

1. Andrew N. Sloss, Dominic Symes, Chris Wright *ARM System Developer's Guide, Designing and Optimizing System Software*, Elsevier
2. Muhammad Ali Mazidi, *ARM Assembly Language Programming & Architecture*, Kindle edition
3. Steve Furber *ARM System-on-chip Architecture*, 2nd Edition, , Pearson publication
4. William Hohl and Christopher Hinds, *ARM Assembly Language, Fundamentals and Techniques*, 2nd edition, CRC Press.

Reference Books

1. Douglas V.Hall, "*Microprocessors and Interfacing",* Tata McGraw Hill, II Edition 2006
2. Mohamed Rafiquzzaman, "*Microprocessors and Microcomputer Based System Design*", II Edition, CRC Press, 2007

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction: Need of advance microprocessors, Difference between RISC and CISC, RISC Design philosophy, ARM Design Philosophy, History of ARM microprocessor, ARM processor family, Development of ARM architecture.	7	15%
II	The ARM Architecture and Programmers Model : The Acorn RISC Machine, ARM Core data flow model, Architectural inheritance, The ARM7TDMI programmer's model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store Architecture, Core extensions, Architecture revisions, ARM development tool.	7	15%
	FIRST INTERNAL EXAMINATION		
III	ARM Instruction set: Data processing instructions, Arithmetic and logical instructions, Rotate and barrel shifter, Branch instructions, Load and store instructions, Software interrupt instructions, Program status register instructions,	8	15%

	Conditional execution, Multiple register load and store instructions, Stack instructions, Thumb instruction set, advantage of thumb instructions, Assembler rules and directives, Assembly language programs for shifting of data, factorial calculation, swapping register contents, moving values between integer and floating point registers		
IV	C Programming for ARM: Overview of C compiler and optimization, Basic C data types, C Looping structures, Register allocations, function calls, pointer aliasing, structure arrangement, bit fields, unaligned data and Endianness, Division, floating point, Inline functions and inline assembly, Portability issues. C programs for General purpose I/O, general purpose timer, PWM Modulator, UART, I2C Interface, SPI Interface, ADC, DAC.	7	15%
SECOND INTERNAL EXAMINATION			
V	Memory management units: Moving from memory protection unit (MPU) to memory management unit (MMU), Working of virtual memory, Multitasking, Memory organization in virtual memory system, Page tables, Translation look aside buffer, Caches and write Buffer, Fast context switch extension.	7	20%
VI	Advanced Microprocessor Bus Architecture (AMBA) Bus System, User peripherals, Exception handling in ARM, ARM optimization Techniques.	6	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
AE312	POWER ELECTRONICS	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To introduce various power semiconductor devices and converters used in industrial applications.

Syllabus

Power semiconductor devices- Controlled rectifiers- DC choppers- DC to AC converters- DC and AC power supplies- Advanced control of power electronic circuits

Expected outcome

- At the end of the semester students will have idea regarding power semiconductor devices, controlled rectifiers, DC chopper, DC to AC converters, DC and AC power supplies and advanced control of power electronic circuits.

Text Books

1. M. H. Rashid, *Power Electronics: Circuits, Devices and Applications*, 3rd ed., Pearson Education, Delhi, 2002
2. N. Mohan, T. M. Underland, and W. P. Robbins, *Power Electronics: Converter, Applications and Design*, John Wiley & Sons, New York
3. P. S. Bimbhra, *Power Electronics*, Khanna Publishers, New Delhi, 2002.

Reference Books

- G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, *Thyristorised Power Controllers*, NewAge International Publishers, New Delhi, 1996

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Power semiconductor devices: Power diodes-types, power transistors, thyristor family, SCRs, Triac, GTOs, power MOSFETs, IGBTs, MCTs-static and dynamic characteristics, protection circuits, series and parallel connections, turn-on characteristics, turn off characteristics	7	15%
II	Controlled rectifiers- single phase and three phase converters-power factor improvements-design of converter circuits-AC volt-age controllers-single phase and three phase-cyclo converters-single phase and three phase, design of AC voltage controller circuits.	7	15%
	FIRST INTERNAL EXAMINATION		
III	DC choppers – principle of step down and step up operations – step down chopper with RL load, Classes of chopper, MOSFET/IGBT choppers.	6	15%
IV	DC to AC converters: Thyristor inverters, McMurray-McMurray Bedford inverter, current source inverter, voltage control waveform control, inverters using devices other than thyristors, vector control of induction motors.	7	15%

SECOND INTERNAL EXAMINATION			
V	DC and AC power supplies: Switched mode, resonant, bi-directional and multistage conversions, buck, boost, buck boost regulators. UPS-block diagram, types. Drive requirements and design of simple drive circuits for power BJT, MOSFET and IGBT.	9	20%
VI	Advanced control of power electronic circuits using microprocessors, microcontrollers, isolation amplifier circuits, synchronization circuits.	6	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
AE331	MICROPROCESSORS & MICROCONTROLLERS LAB	0-0-3-1	2016

Prerequisite : AE305 Microprocessors & Microcontrollers

Course objectives

- To write ALP for arithmetic and logical operations in 8086 and 8051
- To differentiate Serial and Parallel Interface
- To interface different I/Os with Microprocessors

List of Experiments (Out of 18 experiments minimum 12 experiments are compulsory)

8086 Programs using kits :

1.Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Separating Odd and Even numbers
4. Code conversion, decimal arithmetic and Matrix operations.
5. Program for sorting an array
6. Program for string manipulation
7. Floating point operations and searching.

Peripherals and Interfacing Experiments

8. Stepper motor control.
9. Serial interface and Parallel interface
10. A/D and D/A interface and Waveform Generation

8051 Experiments using kits :

11. Basic arithmetic and Logical operations
12. Square and Cube program, Find 2's complement of a number
13. Unpacked BCD to ASCII
14. Program to verify Timer/Counter in 8051
15. Program and verify interrupt handling in 8051
16. UART operation in 8051
17.Communication between 8051 kit and PC
18. Interfacing LCD to 8051.

Expected outcomes

- At the end of the semester students are expected to be familiar with the operations in 8086 and 8051.

Course code	Course name	L-T-P-Credits	Year of introduction
AE332	PROCESS CONTROL LAB	0-0-3-1	2016

Prerequisite : AE302 Process control

Course Objective

- To provide experience on control of various industrial processes using different control paradigms
- To provide experience in development of virtual instrumentation systems for industry applications
- To introduce few novel control strategies based on artificial neural networks, fuzzy logic, digital control algorithm, etc.

LIST OF EXPERIMENTS: (Minimum 12 experiments are to be done)

1 .ON-OFF controller with and without neutral zone-level control, flow control

2. Temperature control using P, PI, PD, and PID controllers–Study of output response

3. Flow control using P, PI, PD, and PID controllers–Study of output response

4. Liquid level control using P, PI, PD, and PID controllers–Study of output response

5. Pressure control using P, PI, PD, and PID controllers–Study of output response

6.Control valve characteristics

7. Controller tuning for various processes – using Ziegler-Nichols rule

8. Controller tuning for various processes – using Cohen and Coon rule

9.Controller Tuning – Simulation

10.Block diagram simulation of a complex control system

11Study of feed-forward, cascade, and ratio controls

12.Data Logger

13. PC based control of robotic actions

14. Simulation of Artificial Neural Networks –use any software

15.Simulation of Heat Exchanger Temperature Control

16. Interface of DCS with PLC/SCADA using protocol/fieldbus

Expected outcome

- The students will be familiar with the concept of process controllers

Course code	Course name	L-T-P-Credits	Year of introduction
AE334	POWER ELECTRONICS LAB	0-0-3-1	2016

Prerequisite : AE312 Power Electronics

Course Objective

- To familiarise the characteristics of power semiconductor devices
- To provide experience on design, testing, and analysis of few power electronic circuits
- To expose simulation of power electronic circuits

Course Plan

LIST OF EXPERIMENTS: (Minimum 12 experiments are to be done)

1. SCR characteristics
2. Triac and Diac characteristics
3. Phase controlled rectifier-resistance triggering
4. Phase controlled rectifier- UJT triggering
5. Chopper circuits
6. MOSFET characteristics
7. Simple DC to AC inverter circuit
8. Driven DC to AC inverter using MOSFET & IC
9. IGBT characteristics
10. Inverter circuit using IGBT
11. Digital triggering circuit for phase controlled rectifiers
12. Application of ICS: PWM IC TL 494, optocoupler IC -MCT2E
13. DC motor speed control – Using digital logic circuits/microprocessor/PC
14. AC motor speed control – Using digital logic circuits/microprocessor/PC
15. Simulation of power electronic converter and inverter circuits using software like MATLAB,PSPIC
16. SCR turn-off circuits using (i) LC circuit (ii) Auxiliary Commutation.
17. AC voltage controller using Triac – Diac combination.
18. Generation of firing signals for Thyristor/Triac using digital Circuit/ Microprocessor.

Expected outcome

- At the end of the semester students will be familiar with the concept of power semiconductor device, power electronics circuits etc

Course code	Course name	L-T-P-Credits	Year of Introduction
AE361	VIRTUAL INSTRUMENT DESIGN	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 few applications in virtual instrumentation.

Syllabus

Review of digital instrumentation - Fundamentals of virtual instrumentation - VI programming techniques - Data acquisition - VI Chassis requirements - Graphical programming environment - Analysis tools and simple applications

Expected outcome

- The students will gain knowledge in virtual instrumentation and some of its applications.

Text Books

1. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.
2. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.
3. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.

Reference Books

1. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2006.
2. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.

WEB RESOURCES:

www.ni.com

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Review of digital instrumentation: - Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.	6	15%
II	Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.	7	15%
	FIRST INTERNAL EXAMINATION		
III	VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.	7	15%

IV	Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. .	6	15%
SECOND INTERNAL EXAMINATION			
V	VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.	8	20%
VI	VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.	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
AE362	INDUSTRIAL PSYCHOLOGY	3-0-0-3	2016

Prerequisite: Nil

Course objectives

- To introduce major topics and sub-specialties including critical theory and research findings that have served to define the field of Industrial / Organizational (I/O) psychology
- To increase understanding of the complicated systems of individual and group psychological processes involved in the world of work
- To connect the basic principles of I/O Psychology to Personnel and Human Resources management within organizations
- To allow participants to explore ways in which individual career choices and work-life success can be improved through the benefits of I/O Psychology

Syllabus

Introduction to Industrial and Organizational Psychology – Leadership - Development of Human Resources - Consumer Psychology - Decision making

Expected outcome

After completing the course the students will be able to:

i. Demonstrate fundamental knowledge about need and scope of I/O Psychology
ii. Be aware of the brief history and various related fields of I/O Psychology
iii. Learn about employee motivation, job satisfaction and leadership styles.
iv. Understand the concept of organizational culture and learn the various types and functions of organizational culture
v. Comprehend the concept of Job analysis and be aware about the various methods of Job analysis.
vi. Learn about the process of employee selection and understand the various methods of selection process with special emphasis on psychological testing.
vii. Demonstrate knowledge about the processes of training and performance appraisal
viii. Understand the meaning of consumer behaviour and the decision making process of the consumer. Level of Basic knowledge of psychological concepts and principles

Text Books

1. Aswathappa K (2008) Human Resource Management (fifth edition), Tata McGraw Hill
2. Blum & Naylor (1982) Industrial Psychology. Its theoretical & social foundations, CBS Publications.
3. Singh N. (2011). Industrial Psychology. Tata McGraw hill Education private limited.

References

1. Aamodt.M G (2016) Industrial/Organizational Psychology: An applied Approach (8th edition), Cengage Learning
2. Miner J B (1992) Industrial/Organizational Psychology. N Y: McGraw Hill
3. Robbins, S. P. (2010). Organizational behaviour. Tata McGraw Hill publications.
4. Schiffman, L G & Wisenblit, J. (2010). Consumer behaviour. Pearson publications.
5. Schultz, D. P., & Schultz, E. S. (2008). Psychology and Work today. New York: Mac Milan publishing company.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	**Introduction to Industrial and Organizational Psychology:** Introduction to industrial psychology, Definition, scope, major influences, goals, key forces, and fundamental concepts, History of industrial psychology, Major Fields of I/O Psychology, scientific management.	6	15%
II	**Individual in Workplace :** Motivation- Definition, Types, Theory-Maslow's and Herzberg, Job satisfaction- Definition, Factors affecting Job Satisfaction, Consequences, Leadership - Definition, Leadership Styles, Approaches to Leadership, Organizational Culture -Definition, Levels, Characteristics, Types, Functions	7	15%
FIRST INTERNAL EXAMINATION			
III	**Development of Human Resources:** Job Analysis- Definition, Purpose, Types, Process, Methods, Recent Developments Recruitment and Selection- Nature and objectives, Sources- Internal and External, Process, Definition and steps in selection process Performance Management- Definition, Scope, Process, Tools Training and Development- Meaning and nature, Objectives, Methods- on the job and off the job	7	15%
IV	**Introduction to Consumer Psychology:** Definition, Scope, Marketing concept. Market Segmentation- consumer rooted, consumption specific, and brand experience as segmentation bases. Targeting- criteria for effective targeting; Positioning and repositioning	7	15%
SECOND INTERNAL EXAMINATION			
V	**Consumer Decision Making :** Levels of Decision making, Views of consumer decision making, Model of consumer decision making: Input – marketing efforts, socio cultural environment. Process – psychological field, need recognition, pre-purchase search, Evaluation of alternatives Output – Purchase behavior and post purchase evaluation.	8	20%
VI	**Performance management: Training & Development:** Work environment & engineering psychology – fatigue, boredom, accidents & safety, Job analysis, Recruitment & Selection, Reliability & Validity of recruitment tests.	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
AE363	VLSI CIRCUIT DESIGN	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To bring circuits and system views on design together.
- To understand the design of digital VLSI circuits for hardware design.

Syllabus

Fundamental considerations in IC processing - NMOS IC technology - CMOS IC technology - BiCMOS IC technology- The MOS device- capacitance of MOS structure – characteristics- Second order MOS device effects- pass transistors and transmission gates -The basic inverter using NMOS- Basic NAND, NOR circuits - The CMOS inverter, - pseudo CMOS- Layout design of static MOS circuits –Stick Diagram –Fabrication-- Combinational circuits- Timing issues in VLSI system design.

Expected outcome

The students will be able

i. to learn layout, stick diagrams, fabrication steps , static and switching characteristics of inverters
ii. to design digital system using MOS circuits.

Text Books

1. Douglas A. Pucknell & Kamran Eshraghian, *Basic VLSI Design*, PHI.
2. Jan M. Rabaey, A. Chandrakasan, B. Nikolic, *Digital Integrated Circuits- A Design perspective*, 2/e, Pearson education.
3. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, Tata Mc-Graw-Hill

References

1. Charles H Roth Jr – *Fundamentals of Logic Design* 4 Ed, Jaico Publishers
2. Mead & Conway , *Introduction to VLSI System Design*-Addison Wesley
3. S M Sze, VLSI Technology, PHI
4. Wayne Wolf: *Modern VLSI Design Systems on Chip*-Pearson Education, 2nd ed.,
5. Weste and Eshraghian, *Principles of CMOS VLSI Design*, A Systems Perspective,2/e, Pearson Education.

Course Plan

Module	Contents	Hours	Semester exam marks
I	VLSI process integration: - fundamental considerations in IC processing - NMOS IC technology - CMOS IC technology - BiCMOS IC technology - GaAs technology. Ion implantation in IC fabrication.	6	15%
II	The MOS device: (n - channel & p- channel) - capacitance of MOS structure - accumulation, depletion and inversion, threshold voltage, current equations - characteristics, channel pinch-off. Second order MOS device effects: short-channel effect, narrow width effect, sub-threshold current, device saturation characteristics.	6	15%
FIRST INTERNAL EXAMINATION			
III	Switch logic- pass transistors and transmission gates, Gate logic-The basic inverter using NMOS-circuit – current	8	20%

	equations - pull up to pull down ratio- transfer characteristics- Alternate forms of pull up. Basic NAND, NOR circuits. The CMOS inverter, characteristics – NAND, NOR and compound circuits using CMOS. Other forms of CMOS logic: pseudo CMOS, CMOS domino logic, n-p logic.		
IV	Layout design of static MOS circuits – Layout rules - general principles & steps of lay-out design - use of stick diagrams - design rules - Layout examples of NAND and NOR-Fabrication.	7	15%
SECOND INTERNAL EXAMINATION			
V	Combinational circuits - clocked sequential circuit - drivers for bus lines. Scaling of MOS circuits: scaling models and scaling factors for device parameters.	7	15%
VI	Timing issues in VLSI system design: timing classification- synchronous timing basics – skew and jitter-latch based clocking- self timed circuit design - self timed logic, completion signal generation, self-timed signalling– synchronizers and arbiters	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
AE364	MEMS/NEMS	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To introduce the concept of MEMS and Microsystems.
- To understand the diverse technological and functional approaches and applications
- To provide an insight of micro sensors, actuators and micro fluidics.

Syllabus

Microsystems - Micro Manufacturing Techniques - Micro Actuators - Micro Sensors - Micro/Nano Fluids - Microsystem Design and Packaging

Expected outcome

On completion of the course, the students will be able to

i. Become familiar with micro fabrication techniques
ii. Assess whether using a MEMS based solution is the relevant and best approach
iii. Select the most suitable manufacturing process and strategies for micro fabrication

Text Book

- Maluf, Nadim "An introduction to Microelectromechanical Systems Engineering "AR Tech house, Boston 2000.

Reference Books:

1. Mohamed Gad – el – Hak "MEMS Handbook" Edited CRC Press 2002
2. Sabrie Solomon "Sensors Handbook", Mc Graw Hill, 1998
3. Marc F Madou, " Fundamentals of micro fabrication," CRC Press 2002 2nd Edition
4. Francis E.H Tay and W. O. Choong, "Micro fluidics and bio MEMS application" IEEE Press
   New York 1997
5. Trimmer William S, "Micromachanics and MEMS", IEEE Press, New York 1997

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	**Foundation in Microsystems** : Review of microelectronics manufacture and introduction to MEMS- Overview of microsystems technology, Laws of scaling- The multi-disciplinary nature of MEMS- Survey of materials central to micro engineering- Applications of MEMS in various industries	6	15%
II	**Micro Manufacturing Techniques** : Photolithography- Film deposition, Etching Processes-Bulk micro machining, silicon surface micro machining	6	15%
	FIRST INTERNAL EXAMINATION		
III	**Micro Actuators** : Energy conversion and force generation-Electromagnetic Actuators, Reluctance motors, piezoelectric actuators, bi-metal-actuator Friction and wear	7	20%
IV	**Micro Sensors** : Transducer principles-Signal detection and signal processing-Mechanical and physical sensors-Acceleration sensor, pressure sensor, Sensor arrays.	7	15%

SECOND INTERNAL EXAMINATION			
V	**Introduction to Micro/Nano Fluids** : Fundamentals of micro fluidics- Micro pump – introduction – Types - Mechanical Micro pump – Non mechanical micro pumps, Actuating Principles, Design rules for micro pump – modeling and simulation, Verification and testing – Applications	8	20%
VI	**Microsystem Design and Packaging :** Design considerations-Mechanical Design, Process design, Realization of MEMS components using Intellisuite. Micro system packaging-Packing Technologies-Assembly of Microsystems- Reliability in MEMS.	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
AE365	INSTRUMENTATION FOR AGRICULTURE	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To impart background information required for studying instrumentation and its application in agriculture.

Syllabus

Necessity of instrumentation & control for agriculture, engineering properties of soil - Flow diagram of sugar plant - fermenter & control - dairy industry - Irrigation systems - irrigation methods - soil moisture measurement methods - Application of SCADA for DAM parameters & control - green houses & instrumentation - Hydraulic, pneumatic & electronics control circuits - classification of pumps–TDR-ground water occurrence confined & unconfined aquifers.

Expected outcome

- At the end of the semester students will have the knowledge about instrumentation in agriculture and some of its applications.

Text Books

1. C D Johnson Process control and instrumentation technology, PHI
2. Patranabis, Industrial instrumentation, TMH.
3. Wills B.A., "Mineral Processing Technology", 4th Ed.,Pergamon Press.

Reference:

- B.G.Liptak , Instrumentation handbook-process control, Chilton

Course Plan

Module	Contents	Hours	Semester exam marks
I	Necessity of instrumentation & control for agriculture, engineering properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength, Mohr's circle of stress, active & passive earth pressures, stability & slopes, Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouples, open & close path gas analysers, brief introduction to various bio-sensors.	8	15%
II	Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control(batch process),flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up for it .	6	15%
	FIRST INTERNAL EXAMINATION		
III	Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems & it's performance, comparison of different irrigation systems, soil moisture measurement methods: resistance based method, voltage based method, thermal based method, details of gypsum block soil moisture sensor, irrigation scheduling, irrigation efficiencies, design considerations in irrigation channels.	7	15%

IV	Application of SCADA for DAM parameters & control, irrigation control management up- stream & down - stream control systems, green houses & instrumentation: ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge carbon dioxide enrichment measurement & control.	6	15%
SECOND INTERNAL EXAMINATION			
V	Automation in earth moving equipments & farm equipments, application of SCADA & PLC in packing industry and cold storage systems, implementation of Hydraulic, pneumatic & electronics control circuits in harvester's cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation.	7	20%
VI	Leaf area length evapotranspiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis, infrared & UV bio sensor methods in agriculture, agro metrological instrumentation weather stations, surface flux measurement, soil water content measurement using time-domain reflectrometery (TDR), ground water occurrence confined & unconfined aquifers, evaluation of aquifer properties, ground water recharge.	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
AE366	EMBEDDED SYSTEM DESIGN	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To impart the basic functions and structure of embedded systems Outcomes.

Syllabus

Embedded Systems Vs General Computing Systems - Purpose of Embedded Systems - Core of the Embedded System – Memory - Embedded Firmware - RTOS Based Embedded System Design - Task Communication - Task Synchronization - Programming concepts of Embedded programming in C Program - Concepts of embedded programming in C++ – Real time operating systems Definitions of process.

Expected outcome

- At the end of the semester students will be able to understand the basic concepts & applications of embedded systems.

Text Books

1. Shibu K.V, *Introduction to Embedded Systems*, Mc Graw Hill
2. Wayne Wolf, *Computers as Components: Principles of Embedded Computing System Design* – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001

Reference Books

1. David E. Simon *An Embedded Software Primer*, Pearson Education.
2. Frank Vahid and Tony Givargis, *Embedded System Design* – A unified Hardware / Software Introduction, John Wiley, 2002.
3. Lyla B Das, *Embedded Systems An Integrated Approach*, Pearson, 2013
4. Rajkamal, *Embedded Systems Architecture, Programming and Design*, TATA McGraw-Hill, First reprint Oct. 2003

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	6	15%
II	Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: On board and External Communication Interfaces.	7	15%
	FIRST INTERNAL EXAMINATION		
III	Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	7	15%

IV	RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.	7	15%
SECOND INTERNAL EXAMINATION			
V	Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication /Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.	7	20%
VI	Programming concepts of Embedded programming in C Program Elements, Macros and functions - Use of Pointers - NULL Pointers - Use of Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers – Concepts of embedded programming in C++ – Cross compiler – Optimization of memory codes. Real time operating systems Definitions of process, tasks and threads.	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
AE368	PLASTIC ENGINEERING	3-0-0-3	2016

Prerequisite: Nil

Course objectives

- To give the concept of plastic engineering and their standards.
- To understand the diverse technological and functional approaches and applications
- To provide an insight of testing, identification and quality control.

Syllabus

Engineering Plastics- Concept of testing & identification of plastics- Test methods and standards for bio-degradable plastics - Recycling technologies for bio degradable plastics - Inspection and quality control of moulds - Environmental consideration

Expected outcome

On completion of the course, the students will

i. become familiar with testing methods and standards of plastic.
ii. be able to test the quality control of different modules.
iii. be able to identify how to engineer along with the environmental consideration.

Text Books

1. Cyril Donaldson, George H.Lecain, V C Goold, Tool Design, TATA McGraw Hill,1998.
2. Fred W. Billmeyer, Jr., Text Book of Polymer Science, John Wiley &Sons, Singapore,1994.
3. G.J.L. Griffin, Chemistry and Technology of Biodegradable Polymers, Blackie Academic Professional, 1994.

Reference Books:

1. Abraham J. Domb, Joseph Kost & David M.Wiseman, Handbook of Biodegradable polymers, CRC Press
2. Dominick V. Rosato, DonaldV. Rosato, Injection Molding Hand Book, CBC Publishers&Distributors,1987
3. Gerald Scott & Dan Gilad, Degradable Polymers-Principles & Applications, Chapman & Hall, 1995.
4. Gordon L. Robertson, Food Packaging Principles and Practice, Marcel Dekker, Inc., New York 1993.
5. IrwinI Rubin, Injection Molding Theory and Practice, Wisely Inter science Publication, 1972.
6. Louis T. Manzione, Plastic Packaging of Microelectronic Devices, Van Nostrand Reinhold, New York, 1990.
7. Plastics Engineering Hand Book of the Society of the Plastics Industry Inc.,Van Nostrand Reinhold Company, 1945.
8. Vishu Shah, Hand Book of Plastics Testing Technology, John Wiley & Sons Inc., New York, 1998.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	**Engineering Plastics :** Sources and Manufacture of raw materials, Methods of Manufacture of Polymer, General Properties and applications of Acrylonitrile Butadiene	8	15%

	Styrene -Polyamides (PA-6,PA-66,PA-6,10,PA-11&12) – Polycarbonates – Poly acetal & Copolymers - Thermoplastic Polyesters (PET&PBT) Poly phenylene oxide – Poly sulfones Fluoropolymers (PVF,PVDF,PTFE,PCTFE) - Thermoplastic Polyurethane.		
II	**Concept of testing & identification of plastics** : Basic concepts of testing - Specification and Standards - National and International Standards - Test specimen preparation - Pre-conditioning and test atmosphere. Identification of plastics by simple tests - Visual examination - Density - Melting point - Solubility test - Flame test - Chemical tests.	8	15%
FIRST INTERNAL EXAMINATION			
III	**Test methods and standards for bio-degradable plastics:** Plastics – criteria used in evaluation of biodegradable plastics – description of current Test methods – Scanning test for ready biodegradability – Test for inherent biodegradability – Test for simulation studies – Other methods for assessing polymer biodegradability	6	15%
IV	**Recycling technologies for bio degradable plastics**: Conventional recycling – Degradable complicate recycling – reprocessing polyethylene starch/film scrap – Economics in in-plant recycling	6	
SECOND INTERNAL EXAMINATION			
V	**Inspection and quality control of moulds** : Introduction to Tool Room measuring instruments – Vernier– Micrometer – Height Gauge–Slip Gauge–Dial Gauge–Measuring tapers and angles–CMM	7	20%
VI	**Environmental consideration**: Plastic waste – Classification, Segregation, Sorting and Waste Management viz. source reduction, reuse/repair, recycling related to packaging films and constrainers. Pollutants an outline – Chloro Fluoro Carbon (CFC), Dioxin Life cycle assessment: A case study	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
AE401	LOGIC & DISTRIBUTED CONTROL SYSTEM	4-0-0-4	2016

Prerequisite: AE301 Control system

Course objectives

- To give an introductory knowledge about PLC and the programming languages.
- To give basic knowledge in the architecture and local control unit of distributed contr ol system.
- To give adequate information in the interfaces used in DCS.
- To give basic knowledge about Computer Controlled Systems.

Syllabus

Programmable Logic Controller - Architecture of PLC - Design of PLC - PLC Basic Functions - Applications Of PLC - Instructions in PLC - PLC programming methods as per IEC 61131 – SCADA - Distributed Control System - Architectures - Interfaces In DCS - Process Safety & Safety Management System - Risk Terminologies - Instrumented System.

Expected outcome

At the end of the course, students will be able to :

i. Understand the basics of PLC and PLC Programming
ii. Know the whereabouts of implementation of SCADA
iii. Reproduce the working of Distributed Control System
iv. Perform the implementation of DCS
v. Recognise the safety procedures to be maintained in an industry

Text Books

1. John. W. Webb Ronald A Reis - Programmable Logic Controllers - Principles and Applications, Fourth edition, Prentice Hall Inc., New Jersey, 1998.
2. Michael P. Lukas, 'Distributed Control Systems', Van Nostrand Reinhold Co.,Canada,1986
3. Petruzella, 'Industrial Electronics', McGraw Hill, Second edition, 1997.

Reference Books

1. Krishna Kant – Computer based Industrial Control, Prentice Hall, New Delhi, 1997.
2. Thomas A. Hughes, 'Programmable Logic Controllers', ISA press,2007.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Programmable Logic Controller : Evolution of PLC's, Components of PLC, Advantages over relay logic, Architecture of PLC, Programming devices, Discrete and Analog I/O modules, Programming languages, Ladder diagram, Programming timers and counters, Design of PLC, Definition of PLC, , overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.	9	15%
II	Applications Of PLC : Instructions in PLC	9	15%

	Program control instructions, math instructions, sequencer instructions, Use of PCas PLC, Application of PLC, Case study of bottle filling system, PLC programming methods as per IEC 61131, Developing programs using Sequential Function Chart, Functional Block Diagram, Analog control using PLC (PID controller configuration), Interfacing PLC to SCADA/DCS using communication link (RS232, RS485) , Protocols (Modbus ASCII/RTU) and OPC, Development stages involved for PLC based automation systems.		
FIRST INTERNAL EXAMINATION			
III	Computer Controlled Systems: Basic building blocks of Computer controlled systems, SCADA, Data Acquisition System, Supervisory Control, Direct digital Control.	7	15%
IV	Distributed Control System : DCS - Architectures, Comparison, Local control unit, Process interfacing issues, Communication facilities. Distributed Control System Basics: DCS introduction, Various function Blocks, DCS components/block diagram, DCS Architecture of different makes, comparison of these architectures with automation pyramid, DCS specification, latest trend and developments, DCS support to Enterprise Resources Planning (ERP), performance criteria for DCS and other automation tools.	10	15%
SECOND INTERNAL EXAMINATION			
V	Interfaces In Dcs : Operator interfaces, Low level and high level operator interfaces, Operator displays, Engineering interfaces, Low level and high level engineering interfaces, General purpose computers in DCS, DCS detail Engineering, configuration and programming, functions including database management, reporting, alarm management, diagnosis.	9	20%
VI	Process Safety & Safety Management System : Process safety and Safety Management Systems: Introduction to process safety, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis (PHA), Hazard and operability study (HaZOp), Safety Integrity Level (SIL), Introduction to IEC61511 standard for Functional safety, protection layers, Safety Instrumented System:	10	20%

	function, architecture, safety life cycle, Application of safety system.		
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
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
AE403	BIOMEDICAL INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To impart knowledge of the principle of operation and design of biomedical instruments.
- To render a broad and modern account of biomedical instruments.
- To introduce idea about human physiology system

Syllabus

Electro physiology- Bioelectric potential and cardiovascular measurements- Respirator and pulmonary measurements and rehabilitation- Patient monitoring systems- Clinical Laboratory Instruments- Imaging technique & Telemetry.

Expected outcome

At the end of the semester students will

i. be able to understand about human physiology
ii. have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering

Text Books

1. Arumugam.M. "*Biomedical Instrumentation*", Anuradha Agencies Publishers, Kumbakonam, 2006.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, Prentice Hall, New Delhi, 1998.

Reference Books:

1. Geddes L. A. and Baker L. E., *"Principles of Applied Biomedical Instrumentation",* 3rd Edition, John Wiley, New York, 1989.
2. John. G. Webster, *"Medical Instrumentation, Application and Design"* John Wiley, New York, 1998
3. R.S.Khandpur, *"Handbook of Biomedical Instrumentation",* Prentice Hall of India, New Delhi, 2003
4. Richard Aston, *"Principles of Bio-medical Instrumentation and Measurement*", Merril Publishing Company, New York, 1990.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Electro physiology: Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems.	7	15%
II	Bioelectric potential and cardiovascular measurements: EMG - Evoked potential response, EEG, foetal monitor. ECG phonocardiography, vector cardiograph, BP, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators.	6	15%
FIRST INTERNAL EXAMINATION			
III	Respirator and pulmonary measurements and rehabilitation:	7	15%

	Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine.		
IV	Patient monitoring systems: Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.	7	15%
SECOND INTERNAL EXAMINATION			
V	Clinical Flame photometer - spectrophotometer – Colorimeter- chromatography- Automated Biochemical analysis system - Blood Gas Analyzer: Blood pH Measurement- Measurement of Blood pCO2- Blood pO2 Measurement- Blood Cell Counters: Types and Methods of cell Counting.	7	20%
VI	Recent trends: Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy.	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 Module 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 Module 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 Module 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
AE405	ADVANCED CONTROL THEORY	3-0-0-3	2016

Prerequisite: AE301 Control system

Course objectives

- To study the basic theory required for solving complex control problems.
- To do analysis and modelling of systems and signals.

Syllabus

Concept of state space - Linear time varying system - Non-linear system - Describing function analysis -Lyapunov stability analysis – Controllability- Observability - Z- Transform - Discrete root locus.

Expected outcome

- At the end of the semester students will have comprehensive knowledge in advanced control theory.

Text Books/Reference books

1. C. D. Johnson, *Process Control Instrumentation Technology*, 7th ed., Prentice Hall of India, New Delhi, 2003
2. K.Ogata "*Discrete Time Control Systems*" , 1996, PHI.
3. K.Ogata "*Modern Control Engineering*" , 1996, PHI.
4. M. Gopal, "*Modern Control System Theory*",New Age International Publishers, 2nd edition,1996
5. Madangopal "*Digital control and state variables methods*" 1997, PHI.
6. R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 8th ed., Pearson Education, Delhi, 2004

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Concept of state space-state space representation of system, solution of time invariant state equation- state transition matrix. Linear time varying system. Discrete system state space representation and solution.	6	15%
II	Non-linear system, types of non-linearity, singular point, non-linear system stability analysis- phase plane technique, construction of phase trajectories, isocline method.	6	15%
	FIRST INTERNAL EXAMINATION		
III	Describing function analysis : Basic concepts, derivation of describing functions for common non-linearities Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.	7	15%
IV	Lyapunov stability analysis- definition of stability, instability and asymptotic stability. Lyapunov stability theorems. Stability analysis of simple linear systems.	7	15%
	SECOND INTERNAL EXAMINATION		

V	MIMO systems-controllability- Observability- Effect of pole-zero cancellation, Practical examples-controllable and uncontrollable systems-observable and unobservable systems. Optimal control system-definition- design using state variable feedback and error squared performance indices.	8	20%
VI	Z- Transform and digital control system- Z-transfer function- block diagram- signal flow graph- discrete root locus.	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
AE407	DIGITAL CONTROL SYSTEM	3-0-0-3	2016

Prerequisite : AE301 Control system

Course objectives

- To study the stability analysis of digital control system
- To equip the basic knowledge of digital process control design

Syllabus

Discrete Data Control Systems - Signal conversion & processing - Z-transform- inverse Z-transform - Digital control systems- Pulse transfer function - Stability tests Frequency domain analysis of discrete systems - State space representation - Controllability and Observability -

Expected outcome

- At the end of the semester Students will have knowledge of digital process control design.

Text Books

1. B. C. Kuo , "*Digital control systems*" (Second Edition) , Oxford University Press, 2007
2. K. Ogatta, "*Discrete Time control systems* ", 2nd ed. (PHI),1995
3. M. Gopal, "*Digital Control systems and state variable methods*", Tata McGraw Hill.

Reference

1. John Dorsey , "*Continuous & Discrete Control Systems* ", (MGH).
2. Nagrath & Gopal , "*Control System Engineering*" (Wiley Eastern).

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction: Basic Elements of discrete data control systems, advantages of discrete data control systems, examples. Signal conversion & processing: Digital signals & coding, data conversion & quantization, sample and hold devices, Mathematical modeling of the sampling process; Data reconstruction and filtering of sampled signals: Zero order hold, first order Hold and polygonal hold.	6	15%
II	Review of Z transform. z transform and inverse z transform . Relationship between s- plane and z- plane- Difference equation . Solution by recursion and z-transform.	6	15%
	FIRST INTERNAL EXAMINATION		
III	Digital control systems- Pulse transfer function . z transform analysis of closed loop open loop systems- Modified z- transfer function- Stability of linear digital control systems	8	20%
IV	Stability tests- Steady state error analysis- Root loci - Frequency domain analysis- Bode plots- Gain margin and	8	20%

	phase margin		
SECOND INTERNAL EXAMINATION			
V	Review of state space techniques to continuous data systems, state space representation of discrete time systems- Transfer function from state space model-various canonical forms- conversion of transfer function model to state space model-characteristics equation- solution to discrete state equations.	7	15%
VI	Controllability and Observability - Response between sampling instants using state variable approach-Pole placement using state feedback . Dynamic output feedback- Effects of finite wordlength on controllability and closed loop pole placement-	7	15%
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
AE409	OPTICAL INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To understand the basic concepts of fiber optics.
- To study optical communication and optical instruments.
- To provide basic knowledge in Laser and its application.

Syllabus

Principle of Optical fiber - Numerical aperture - Types of optical fibers - Optical sources- Optical detectors - Fibre optic sensors - Different types of modulators – Interferometers - Interference filters - Optical spectrum analyzer - Lasers - Population inversion - Semiconductor lasers - Laser Doppler Anemometry - Medical application of lasers.

Expected outcome

- At the end of the semester the students will have knowledge of optical fiber and optical instrumentation techniques.

Text Books/Reference books

1. G. Keiser, “Optical Fibre Communication”, McGraw Hill, 1995.
2. J.Wilson and J.F.B.Hawkes , “Optoelectronics: An Introduction”, Prentice Hall of India.
3. John F. Ready, “Industrial Applications of Lasers”, Academic Press, 1978.
4. John M. Senior, “Optical Fiber Communications-Principles and Practice”, Pearson Education Limited.
5. K.Thygarajan and A.K.Ghatak , “Lasers: Theory and Applications “, Plenum Press.
6. O.Svelto , “ Principles of Lasers “ ,Plenum Press.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Principle of Optical fiber – Acceptance angle and acceptance cone –Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – properties- Optical sources-Optical detectors. Optical fiber production and fabrication.	6	15%
II	Fibre optic sensors – Fibre optic instrumentation system for measurement of fibre characteristics – Different types of modulators – Interferometric method for measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain – fiber optic gyroscope. Source coupling- Fiber connection-Splicing Techniques.	8	15%
FIRST INTERNAL EXAMINATION			
III	Interferometers – Fabry – perot and Michelson interferometers – Interference filters – Interferometeric method of measurement – Interference filters – Interferometeric method of measurement of optical components – Optical spectrum analyzer.	7	15%

IV	Lasers – Principles of operation – Einstein relations – Population inversion – Optical feedback – laser modes – Classes of laser – Solid state, gas and liquid dye lasers– Semiconductor lasers – Q-switching and mode locking – Properties of laser light.	6	15%
SECOND INTERNAL EXAMINATION			
V	Laser applications: Laser for measurement of distance, length, atmospheric effect and pollutants-Laser Doppler Anemometry (LDA) - Material processing: Laser heating, Melting, Scribing, Trimming, Welding.	8	20%
VI	Medical application of lasers- Laser and Tissue interaction-Laser diagnosis-Laser instruments for microsurgery, Removal of tumors of vocal chords, Brain surgery, dermatology, Oncology and Ophthalmology.	7	15%
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
AE431	CONTROL SYSTEM AND SIGNAL PROCESSING LAB	0-0-3-1	2016

Prerequisite : AE301 & AE306

Course objective

- To give hands on experience in various digital Signal Processing techniques using TMS 320C6X family processors and in control system analysis using MATLAB.

List of Experiments

CONTROL SYSTEM LAB using MATLAB

1. Familiarization of MATLAB commands used in control system design
2. Representation of system in MATLAB: state space representation & transfer function representation
3. Stability analysis using Bode plot, root locus & their pole-zero-gain representation.
4. Implementation of Ziegler- Nicholas/ Cohen-coon tuning method for 1st order system.
5. Analysis of a closed loop system.
6. Implementation of PID control using both m-file and Simulink.
7. Pole placement technique applied to stabilize a system.
8. Realization of a compensator design.
9. Modelling and analysis of a first order system.
10. Modelling of an unstable system (inverted pendulum, ball & plate system etc.)

PC Based Control

1. PLC programming: familiarization of instruction set.
2. PLC programming: simulation of process control.
3. SCADA interface.
4. Familiarization of Distributed Control System (DCS) with different process stations pressure, flow and level.

LabVIEW based Virtual Instrumentation

1. Getting started with LabVIEW: Basic operations, controls, indicators, and simple Programming structures.
2. Debugging a VI and sub-VI.
3. Familiarization of DAQ card.

SIGNAL PROCESSING LAB

1. Familiarization of signal processing commands used in MATLAB Software.
2. Developing elementary signal function modules (m-files) for unit impulse, step, exponent and ramp sequence.
3. Generating continuous and discrete time sequences.
4. Carrying out mathematical operations on signals.
5. Response of LTI system described by difference and differential equation.
6. Developing a program for computing inverse Z-Transform.
7. Developing program for finding magnitude & phase response of LTI System
8. Developing program for computing DFT & IDFT.
9. Developing a program for computing circular convolution.
10. Design of filter: FIR, IIR, ECG Signal filter (can be done as 3 separate experiments).

Expected outcome

- At the end of the semester students are expected to be familiar with the basic signal processing & control system techniques**.**

Course code	Course name	L-T-P-Credits	Year of Introduction
AE461	ARM SYSTEM ARCHITECTURE	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To introduce the concepts of embedded processors and ARM based development.

Syllabus

Embedded Computers - Embedded System Design - ARM Architecture - Instruction Set - ARM Processor –Assembly programming - Component Interfacing - ARM interfacing programs - Peripherals In ARM Processors - Peripherals and their control - ARM tools and Peripherals - Arm Procedure Call Standard - Example C program.

Expected outcome

- At the end of the semester students must be able to obtain comprehensive knowledge in embedded processors and ARM based system.

Text Books

1. Steve Furber, "*ARM system on Chip Architecture", 2nd Edition, Addison Wesley Publishers*, 2013
2. Wayne Wolf, "*Computers as Components Principles of Embedded Computing System Design*", Morgan Kaufman Publishers, 2001

Reference Books:

1. David Seal, "*ARM Architecture Reference Manual*", 2nd Edition, Addison Wesley Publishers, 2001
2. Frank Vahid and Tony. D.Givargis, "*Embedded System Design - A Unified Hardware/Software Introduction*", John Wiley Sons, 2000.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Embedded Computers – Characteristics of Embedded Computing Applications–Challenges in Embedded Computing. Embedded System Design –Process Requirements – Specification	6	15%
II	ARM Architecture: The ARM Instruction Set Architecture. Bus structure and the peripherals. Register set, Exception modes, Software Interrupt.	6	15%
	FIRST INTERNAL EXAMINATION		
III	ARM Processor – Memory organization and processor initialization [start up code]. Load store instruction set. Assembly programming using Assemblers, Linkers, Loaders and Debuggers. Component Interfacing – Designing with Microprocessor Development and Debugging – Design Example Alarm Clock	8	15%
IV	ARM interfacing programs: GPIO, Timers, Counters, PWM, ADC. Application coding examples: Measurement and control of time, frequency velocity acceleration, power	8	15%

	control and touch monitoring		
SECOND INTERNAL EXAMINATION			
V	Peripherals In ARM Processors: ARM / THUMB architecture. Program structure to Supervisor, Kernel, and User modes. Peripherals and their control: GPIO, Timers, Counters, PWM, ADC and serial communication channels.	7	20%
VI	ARM tools and Peripherals: ARM Development Environment, Arm Procedure Call Standard (APCS), Example C program.	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
AE463	AEROSPACE & NAVIGATION INSTRUMENTS	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To introduce the basics of aerospace engineering
- To impart ideas on aircraft and navigation instruments

Syllabus

History of aviation and space flight - - basics of aerodynamics - Airplane performance- Introduction to turbojet and turbofan engines- Basic engine instruments- Aircraft compass- Air speed indicator- GPS and GNSS- Introduction to guidance, navigation and avionics- Introduction to navigation and guidance instrumentation- MEMS gyroscopes and accelerometers.

Expected outcome

At the end of semester, the students will

i. be familiar with the basics of aerospace engg and navigation
ii. have an idea about the instrumentation used in aerospace engineering

Text Books

1. Nagaraja.M.S, Elements of electronic navigation, Tata McGraw Hill
2. Pallet.E.H.J , Aircraft instruments- Principles and applications, Pitman Pub

Reference books

1. Ernest O Doebelin, Dhanesh N Manik , Measurement Systems-Application and Design,5th Edition, Tata McGraw Hill, 2007
2. Jewel B Barlow, William H. Rae, Jr. , Alan Pope , Low-Speed Wind Tunnel Testing, , John Wiley, Third Edition, 1999
3. Marcel J. Sidi, Spacecraft Dynamics and Control-A Practical Engineering Approach, , Cambridge University Press, 1997.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	History of aviation and space flight- anatomy of airplane and space vehicle with emphasis on control surfaces- airfoil nomenclature- basics of aerodynamics to illustrate lift and drag- types of drag – finite wings – swept wings –flaps.	6	15%
II	Airplane performance- thrust –power- rate of climb absolute and service ceiling- range and endurance. Introduction to turbojet and turbofan engines. Space vehicle trajectories- Kepler's laws- rocket engines, propellants and staging. (Introductory treatment of the above topics is only expected, no detailed derivations)	8	15%
	FIRST INTERNAL EXAMINATION		
III	Basic engine instruments- Capacitive fuel content- Gauges. Standard atmosphere- Altimeters Aneroid and radio	6	15%

	altimeters.		
IV	Aircraft compass- Remote indicating magnetic compass- Rate of climb indicator- Pitot static system- Air speed indicator- Mach meters- Integrated flight instruments	6	15%
SECOND INTERNAL EXAMINATION			
V	GPS and GNSS, - Automatic Pilots- Aircraft flight simulation instrumentation Introduction to guidance, navigation and avionics- Radio navigational aids- automatic direction finder VHF- Phase-Comparison direction finder.	8	20%
VI	Introduction to navigation and guidance instrumentation- Principle, construction and applications of inertial sensors- Gyroscope and accelerometers- Ring laser gyroscope- Fibre optic gyroscope, MEMS gyroscopes and accelerometers.	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
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
AE465	INFORMATION SECURITY	3-0-0-3	2016

Prerequisite : Nil

Course Objective

- To understand the threat models and the basic types of authentication mechanisms
- To analyse cryptographic techniques, protocols, formats, and standards.
- To analyse different log files and understand Cyber laws to recover and secure the data.

Syllabus

Introduction to security and services-Cryptography- Securing the systems-Network security topics-Network perimeter security-Computer forensics and Cyber laws

Expected outcome

At the end of the semester students will be able

i. to apply cryptographic algorithms to avoid data accessing by unauthorized users
ii. to implement security algorithms as per the need of organization.

Text Books

1. Bruce Schneier, "*Applied Cryptography"*, Second Edition, John Wiley & Sons, 1996
2. Charlie Kaufman, Radia Perlman, and Mike Speciner, "*Network Security*: Private Communication in a Public World", 2nd Edition, Prentice Hall, 2002.
3. Rick Lehtinen, G. T. Gangemi, SR.,"*Computer Security Basics"*, Second Edition, O'Reilly Pubs, June 2006.

Reference Books:

1. Marije, "*Computer Forensics and Cyber Crime"*: An Introduction, Prentice Hall, 2004.
2. Stephen Northcutt, Karen Kent, and Lenny Zeltser, "*Inside Network Perimeter Security",* Sams Publications, 200
3. William Stallings, "*Cryptography and Network Security"*, Fourth Edition, Prentice Hall, 2005

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction to security and services, vulnerabilities and countermeasures, malicious code, goals of security-prevention, detection, and recovery.	6	15%
II	Cryptography-Types of encryption, confidentiality using symmetric encryption, PKI, RSA, Key management, Diffie- Hellman, ECC, CA, etc., authentication protocols.	6	15%
	FIRST INTERNAL EXAMINATION		
III	Securing the systems-Network security protocols: SSL, IPSEC, Kerberoes, X.509 Authentication service, Electronic mail security S/MME, Application security- SSL, PGP, SET.	7	15%

IV	Network security topics: Network layer security – IPSec – overview, IP and IPv6, IPSec Protocols: AH and ESP, Tunnel Mode and transport mode. Internet Key exchange Protocol- IPSec cookies.	7	15%
SECOND INTERNAL EXAMINATION			
V	Network perimeter security-Secured router configuration, firewall, design principles, trusted systems, VPN, IDS, IPS penetration testing, NAT.	8	20%
VI	Computer forensics and Cyber laws- data recovery, security policies and procedures, Security lifestyle management, security audit, managed security services.	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
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
AE467	CMOS CIRCUIT DESIGN	3-0-0-3	2016

Prerequisite: EC204 Analog integrated circuits

Course objectives

- To give ideas about basic amplifiers, current Mirrors and Differential Amplifiers
- To impart idea of static and switching characteristics of the CMOS Inverter
- To study the operation of pass transistor logic and transmission gates
- To analyse Operational Amplifiers on its design and stability factors
- To familiarise different types of Memory and its decoder Circuits

Syllabus

Review of single stage MOS Amplifiers - current Mirrors - Differential Amplifiers - CMOS Inverter - Sequential Logic Circuits- Different CMOS Flip flop - MOS Operational Amplifiers- Stability and frequency compensation in Op amps - Design of a two stage Op amp - CMOS Circuit and Logic Design - Arithmetic Circuits in CMOS VLSI - Low power design - Designing Memory and Array Structures- Designing Combinational Logic Gates in CMOS.

Expected outcome

- At the end of the semester students will be able to obtain comprehensive knowledge in CMOS Circuit Design.

Text Books

1. Douglas A. Pucknell and K. Eshragian., "*Basic VLSI Design*" 3 rd Edition. PHI, 2000.
2. John P. Uyemura, "*Introduction to VLSI Circuits and Systems*", John Wiley & Sons 2002
3. Kesshab K. Parhi, "VLSI DIGITAL SIGNAL PROCESSING SYSTEMS", John Wiley & Sons 2002
4. Neil. H.E. Weste and K. Eshragian, "*Principles of CMOS VLSI Design*". 2 nd Edition. Addison-Wesley , 2000.
5. R. Jacob Baker, Harry W. LI., & David K. Boyce., "*CMOS Circuit Design*", 3 rd Indian reprint, PHI, 2000.

References

1. Jan M. Rabaey and et al, "*DIGITAL INTEGRATED CIRCUITS*", Pearson Edn. Inc. 2003
2. Kang & Leblebigi "*CMOS Digital IC Circuit Analysis & Design*"- McGraw Hill, 2003
3. Weste and Eshraghian, "*Principles of CMOS VLSI design" Addison*-Wesley, 2002

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Review of single stage MOS Amplifiers CS, CD, CG and cascode Amplifiers . Design of current Mirrors, Wilson current mirrors and Widlar current mirrors. Band gap voltage reference Differential Amplifiers: MOS Load Current Source, Current Mirror, Cascade Load.	6	15%
II	CMOS Inverter-Static Characteristics, Derivation for VTH,	7	15%

	V IL and VIH Switching Characteristics and Calculation of delay times Sequential Logic Circuits- Different CMOS Flip flops Theory of operation and Circuits of Pass transistor Logic and transmission gate.		
FIRST INTERNAL EXAMINATION			
III	MOS Operational Amplifiers, Cascode and Folded Cascode opamps . Stability and frequency compensation in Op amps. Design of a two stage Op amp DRAM, SRAM, Sense Amplifiers, Design of Row and Column Decoders Flash Memory- NOR and NAND Flash Memory Cell	7	15%
IV	CMOS Circuit and Logic Design-CMOS Logic structures. Advanced techniques in CMOS Logic Circuits-Mirror circuits, Pseudo NMOS, Tri-state circuits, Clocked CMOS, Dynamic CMOS Logic circuits, Dual Rail Logic Networks.	7	15%
SECOND INTERNAL EXAMINATION			
V	Arithmetic Circuits in CMOS VLSI-Bit Adder Circuits, Ripple Carry Adder, Carry Look Ahead Adders, Other High speed adders-Multiplexer based fast binary adders, Multipliers-Parallel multiplier, Wallace Tree and Dadda multiplier, Low power design- Scaling Versus Power consumption, Power reduction techniques.	8	20%
VI	Designing Memory and Array Structures - Memory classification, Memory Core - Read Only Memories, Non-volatile Read Write Memories, Read Write Memories, Content - Addressable or Associative Memories, Memory Peripheral Circuits - Address Decoders, Sense Amplifiers, Designing Combinational Logic Gates in CMOS.	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.

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Part B

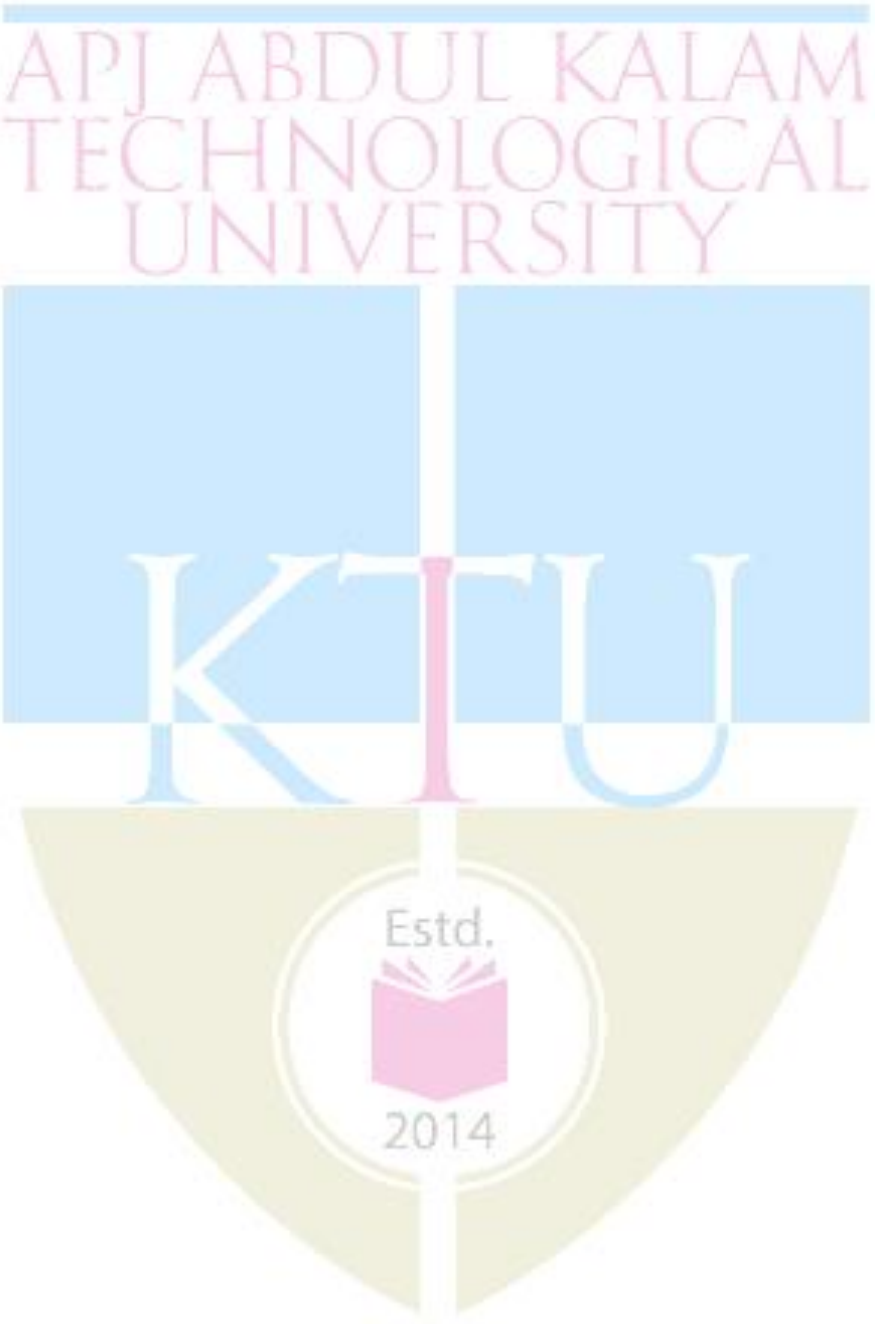
Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(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

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Part B

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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)