Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. V Semester

Electronics Instrumentation & Control

Rajasthan Technical University, Kota

Effective from session: 2019-20

5EI3-01: Digital Signal Processing

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes,	10
3	Z-Transform, Analysis of LSI systems, frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems.	08
4	Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to mult-irate signal processing. Application of DSP.	10
5	Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters.	11
	Total	40

5EI4-02: Sensors And Transducers

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Introduction: Concepts and terminology of measurement system, transducer, sensor, Role of transducers - selection criteria, range and span, classification of transducers, applications of transducers, static and dynamic characteristics, sources of errors and their statistical analysis, standards and calibration.	08
3	Displacement Measurement: Fundamental Standards, Calibration, Resistive Potentiometer, Resistance Strain Gages, Differential Transformers, Induction Potentiometer, Variable Inductance and Variable Reluctance Pickup, Eddy current Non-contact type Transducer, Capacitance Pickup, Piezoelectric Transducers, Digital Displacement transducers: translation and rotary encoders, Ultrasonic transducers.	08
4	Velocity Measurement: Calibration, Velocity by electrical differentiation of displacement voltage signals, Average velocity from measurement of Δx and Δt, Mechanical fly ball angular velocity sensor, Mechanical revolution counters and timers, Magnetic and photoelectric pulse counting methods, Stroboscopic Methods, Translation velocity transducers : moving coil and moving magnet pickups, DC Tachometer generator for rotary velocity measurement, AC Tachometer generator for rotary velocity measurement, Eddy current drag-up tachometer.	10
5	Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement.	08
6	Strain Measurement: Potentiometers, metal and semiconductor strain gauges and their signal conditioning circuits, Electrical strain gauges Wire & foil type materials, Adhesives, Protective coatings, Bonding, Temp. Compensation, Calibration, Applications Rosette gauges.	07
	Total	42

5EI4-03: Control System-I

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Systems and their representation: Terminology and basic structure of control system, Open loop and Closed loop systems, servomechanism, regulatory system, analogous systems, electrical analogy of physical systems, Physical Systems and their models, transfer function, Block diagram representation of physical systems, Block diagram algebra, Signal Flow graph and Mason's formula.	10
3	Time response: Types of test inputs, Response of first and second order system, Time domain specifications, Error coefficients, generalized error series. Concepts of stability: Characteristic equation, location of roots in s-plane for stability, asymptotic stability and relative stability, Routh-Hurwitz stability criterion.	08
4	Control system components: Potentiometers, synchros, Armature & Field controlled DC servomotors, AC servomotors, stepper motor and ac tacho generator.	06
5	Root Loci: Effect of pole zero addition, desired closed loop pole location, Root locus plot, Properties of Root loci and applications, Stability range from the loci. Determination of roots of the closed loop system, transient response and stability from root locus.	08
6	Frequency response: Frequency-domain techniques – Nyquist and Bode plots, Frequency response for systems with transportation lag, Frequency-domain specifications. Nyquist stability criterion, Bode plots- gain margin and phase margin.	07
7	Elementary ideas of compensating networks: Lag, Lead and Lag lead networks. Brief idea of proportional, derivative and integral controller.	02
	Total	42

5EI4-04: Biomedical Instrumentation

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	TRANSDUCERS AND ELECTRODES- Principles and classification of transducers for Bio-medical applications, Electrode theory, different types of electrodes, Selection criteria for transducers and electrodes.	03
3	BIOPOTENTIALS- Electrical activity of excitable cells, ENG, EMG, ECG, ERG, ECG. Neuron potential.	02
4	CARDIOVASCULAR SYSTEM MEASUREMENTS- Measurement of blood pressure, blood flow, cardiac output, cardiac rate, heart sounds, Electrocardiograph, phonocardiograph, Plethysmograph, Echocardiograph.	02
5	INSTRUMENTATION FOR CLINICAL LABORATORY Measurement of pH value of blood, ESR measurement, hemoglobin measurement, O2 and CO2 concentration in blood, GSR measurement. Spectrophotomentry, chromatography, Hematology,	04
6	MEDICAL IMAGING: Diagnostic X-rays, CAT, MRI, thermography, ultrasonography, medical use of isotopes, endoscopy.	03
7	PATIENT CARE, BIOTELEMETRY AND SAFETY MEASURES Elements of Intensive care monitoring basic hospital systems and components, physiological effects of electric current shock hazards from electrical equipment, safety measures, Standards & practices. Biomedical Telemetry: Introduction, block diagram and description of single channel/multi channel telemetry systems.	06
8	THERAPEUTIC AND PROSTHETIC DEVICES - Introduction to cardiac pacemakers, defibrillators, ventilators, muscle stimulators, diathermy, heart lung machine, Hemodialysis, Applications of Laser.	02
9	APPLICATIONS OF BIOPOTENTIALS: Electrocardiographic diagnostic criteria for Identification of cardiac disorders, Electrocardiographic pattern of ischemia, Atrial abnormalities, Ventricular enlargement, Abnormal ECG patterns, Clinical applications of EEG, EMG, ERG	03
10	COMPUTER APPLICATIONS: data acquisition and processing, remote data recording and management. Real time computer applications	02
	Total	28

5EI4-05: Industrial Instrumentation

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	TEMPERATURE MEASUREMENT- Thermocouples, Resistance Temperature detectors: 2-wire, 3-wire systems, Thermistors, Radiation and optical pyrometers, Infrared pyrometers, Calibration of temperature sensors.	05
3	PRESSURE MEASUREMENTS - Electric pressure transducers: LVDT, strain guage, Capacitive pressure transducers, Piezo electric pressure transducers, Potentiometric pressure transducer, Low pressure measurement: McLeod gauge, Thermal conductivity: Thermocouple type, Differential pressure transmitters, Calibration of pressure gauge: Dead weight tester.	10
4	FLOW MEASUREMENTS - Orifice, Venturi, Flow nozzles and pitot tubes, Rotameters, Vortex flowmeters, Electromagnetic flow meters, Ultrasonic flow meter, thermal flow meter, Mass flow type meters, Shunt flow meters.	08
5	LEVEL MEASUREMENTS - Float gauge, Bubbler (Purge) system, Hydrostatic pressure type in open vessels and closed vessels, Differential pressure method, Electrical conductivity method, Capacitance type, Radioactive type, Ultrasonic type.	08
6	DENSITY MEASUREMENTS - Ultrasonic densitometer, radiation densitometer, Impulse wheel methods.	04
7	RECORDER- Operating mechanism, Chart drive mechanism, Strip chart recorders, Circular chart recorders, X-Y type recorders, Magnetic tape recorders.	05
	Total	41

5EI5-11: Control System Component

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Motors: Types, working principle, characteristic, and mathematical model of following: Motors AC/DC motors, stepper, servo, linear, Synchronous, Generators, and Alternator.	05
3	Types, working principle, characteristics, and symbolic representation of following: Switches: Toggle, Slide, DIP, Rotary, Thumbwheel, Selector, Limit, Proximity, Combinational switches, zero speed, belt sway, pull cord. Relays: Electromechanical, Solid state relays, relay packages Contactors: Comparison between relay & contactor, contactor size and ratings Timers: On Delay, Off delay and Retentive.	06
4	Sequencing & Interlocking for motors: Concept of sequencing & Interlocking, Standard symbols used for Electrical Wiring Diagram, Electrical Wiring diagrams for Starting, Stopping, Emergency shutdown, (Direct on line, star delta, soft starter) Protection devices for motors: Short circuit protection, Over load Protection, Over/ under voltage protection, Phase reversal Protection, high temperature and high current Protection, over speed, Reversing direction of rotation, Braking, Starting with variable speeds, Jogging/Inching Motor Control Center: Concept and wiring diagrams.	08
5	Pneumatic components: Pneumatic Power Supply and its components: Pneumatic relay (Bleed & Non bleed, Reverse & direct), Single acting & Double acting cylinder, Special cylinders: Cushion, Double rod, Tandem, Multiple position, Rotary Filter Regulator Lubricator (FRL), Pneumatic valves (direction controlled valves, flow control etc), Special types of valves like relief valve, pressure reducing etc. Hydraulic components: Hydraulic supply, Hydraulic pumps, Actuator (cylinder & motor), Hydraulic valves.	07
	Total	27

5EI5-12: Computer Network

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.	06
3	Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Cross bar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches ,switch fabric, Buffering, Multicasting,Statistical Multiplexing.	06
4	Transport layer: Connectionless transport - User Datagram Protocol, Connection oriented transport –Transmission Control Protocol, Remote Procedure Call. Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.	06
5	Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing	04
6	Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.	04
	Total	27

5EI5-13: Probability Theory & Stochastic Process

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.	04
3	Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;	06
4	Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds;	05
5	Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.	06
6	Random process. Stationary processes .Mean and covariance functions. Ergodicity. Transmission of random process through LTI.Power spectral density.	05
	Total	27

5EI4-21: Transducer Lab

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**
0L+0T+3P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	To draw the characteristics of following temperature transducers: - (a)PT 100 (b) Thermistor (c) K Type Thermocouple
3	To perform experiment on ultrasonic depth meter.
4	Water level measurement kit: a) To draw I/P vs O/P characteristics. b) Study of water level indication. To plot the curve between error and different measured water level.
5	Load Cell Kit: a) To perform experiment and plot curve between load and strain. b) To study about excitation. To plot error curve at different loads.
6	To study Piezo electric vibration pickup.
7	LVDT Kit: a) To study excitation and balancing network. b) To study phase difference. To plot curve between displacement and output voltage.
8	Torque measurement Kit: a) To study about unbalanced strain. To plot the curve between torquevss train.
9	To draw characteristics of LDR.
10	To draw Characteristics of Hall effect sensor.
11	Design of Opto-coupler using photoelectric transducers.
12	To study various pressure sensors like Bourdon tube, Diaphragms, Pressure switches, Bellows etc.

5EI4-22: Biomedical Instrumentation Lab

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**
0L+0T+2P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	Measurement of optical power attenuation and numerical aperture in a plastic optical fiber.
3	Study and measurement of losses in optical fiber.
4	Measurements of various amplitudes and time intervals between each segment of ECG, Measurement of R-R interval and calculation of Heart Rate.
5	Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle.
6	Measurement of Heart rate variability (HRV) and analysis using time and frequency based approach.
7	Recording of blood pressure using sphygmomanometer & stethoscope and relate with heart rate.
8	Recording of the EMG Signal for different stress on the muscle.
9	To find out various lung capacity measurements using pneumotachograph.
10	Study of EEG Signal, to measure the amplitude, frequency & nature of EEG.
11	Design of an instrumentation amplifier for amplification of the low level ECG signals for gain 1000 and CMRR >100 dB and flat frequency response from 4 to 40 Hz.

5EI4-23: Control Lab

Credit: 1.5 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+3P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	To design I order system on R-C circuit and observe its response with the following inputs and trace the curve. (a) Step (b) Ramp (c) Impulse.
3	To design II order electrical network and study its transient response for step input and following cases:- (a) Under damped System (b) Over damped System (c) Critically damped System.
4	To Study the frequency response of following compensating networks, plot the graph and find out corner frequencies:- (a) Lag Network (b) Lead Network (c) Lag-lead Network.
5	To perform experiment on stepper motor (finding step angle and frequency response etc.)
6	To perform experiment on Potentiometer error detector.
7	To perform experiments on Position control system using dc servomotor.
8	a) To draw the error Vs angle characteristics of Synchro transmitter. b) To draw the characteristics of Synchro transmitter and control transformer.
9	To perform experiments on relay control system.
10	a) To find Transfer Function of a.c. servo motor. b) To draw Torque Speed Characteristics of a.c. servo motor.
11	a) To find Transfer Function of d.c. servo motor. b) To draw Torque Speed Characteristics of armature controlled d.c. servo motor.
12	To identify a system T.F. using its frequency response.
13	To perform experiments on magnetic levitation systems.

Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. VI Semester

Electronics Instrumentation & Control

Rajasthan Technical University, Kota

Effective from session: 2019-20

6EI3-01: Optical Instrumentation

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	OPTICAL FIBER OVERVIEW- Introduction, Ray theory, Optical fibers: multimode, single mode, step index, graded index, plastic & glass fibers. Transmission Characteristics of Optical Fibers - Introduction, Attenuation, Material absorption loss, Fiber bend loss, scattering, Dispersion (intermodal &intramodal), Dispersion Shifted Fibers, Dispersion Compensating Fibers. Manufacturing of optical Fibers – preparation of optical fiber, Liquid phase techniques, Vapour phase depositions techniques.	10
3	OPTICAL FIBER SOURCES- Laser- Emission and absorption of radiation, Einstein relation, Absorption of radiation, Population inversion, Optical feedback, Threshold condition. Population inversion and threshold, working of three levels & four level laser. Basic idea of solid state, semiconductors, gas & liquid laser. Basic concept of Q-switching and mode locking. Light Emitting Diode - Structure, Material, Characteristics, Power & Efficiency.	10
4	OPTICAL DETECTORS & CONNECTION - Optical detection principles, quantum efficiency, Responsivity, PIN photo diode, Avalanche photo diodes, Noise in Detectors, Photo Diode Materials. Fiber Alignment, fiber splices, fiber connectors, expanded beam connectors, fiber couplers.	06
5	OPTICAL FIBER MEASUREMENTS - Measurements of Fiber Attenuation, Dispersion, Refractive Index Profile, Cut off Wave Length, Numerical Aperture & Diameter. Field measurement through optical time domain reflectometry (OTDR), Laser based systems for measurement of distance, Velocity, Holography.	08
6	OPTICAL FIBER APPLICATIONS – Wavelength division multiplexing, DWDM, active and passive components, optical sensors, optical amplifiers, public network applications, military, civil and industrial applications.	06
	Total	41

6EI4-02: Power Electronics

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	SEMICONDUCTOR POWER DEVICES: Introduction. Basic characteristics &working of Power Diodes, Diac, Triac, MOSFETs, IGBT, GTO, Power Transistor and SCR- Principle of operation, V-I Characteristics, Turn-On mechanism and its applications	05
3	CONVERTERS: Basic concept, Working Principles of Single phase half Wave bridge converter, Single Phase Full Bridge Converter, 3 Phase Bridge Converter.	04
4	INVERTERS: Voltage Source Inverter, Current Source Inverter, PWM Control of Voltage Source Converter and applications.	06
5	INDUSTRIAL POWER SUPPLIES: Principle of operation of choppers. Step up, Step down and reversible choppers. Chopper control techniques, High frequency electronic ballast, Switch Mode Power Supply: Fly back converter, forward/buck converter, Boost converter and buck-boost converter. Uninterruptible Power Supply.	08
6	MOTOR CONTROL: Introduction to speed control of DC motors using phase controlled converters and choppers, Basic idea of speed control of three phase induction motors using voltage and frequency control methods.	08
7	STEPPER MOTORS: Principle of operation, Types of stepper motor: Variable reluctance, Permanent magnet and hybrid stepper motors. Brushless DC motor and its control. Induction and dielectric heating control.	08
	Total	40

6EI4-03: Control System II

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	State space Model- Review of vectors and matrices, Canonical Model from Differential Equations and Transfer Functions, Interconnection of Subsystems.	08
3	Analysis of Linear State Equations- First Order Scaler Differential Equation, System modes and modal decomposition, State Transition Matrix, Time –varying matrix case, Solution of state equations. Pole placement by state feedback, Ackermann's Formula.	12
4	Lyapunov's stability theory for Linear System- Equilibrium points and stability concepts, Stability Definitions, Linear system stability, The Direct method of Lyapunov, Use of Lyapunov's method in feedback design.	10
5	Controllability &Observability- Definitions, Controllability/Observability Criteria, Design of state feedback control systems, Full-order and Reduced-order observer Design, Stabilizability and Detectability	10
	Total	41

6EI4-04: Process Control System

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	GENERAL CONCEPTS: General Concepts and terminology, Piping and Instrumentation diagram	02
3	TYPES OF DYNAMIC PROCESS: Instantaneous, Integral, First and second Order, self-regulating, interacting and non-interacting processes. Dead time elements	03
4	MATHEMATICAL MODELING OF SYSTEMS: Liquid Systems (Level and flow), perturbation variable and linearization methods. Response of a thermometer bulb, Concentration response of a stirred tank. Temperature response of a stirred tank, Process lag, load disturbance and their effect on processes.	06
5	BASIC CONTROL ACTION: Basic control action, two position, multi Position, continuous controller modes: proportional, integral and Derivative Composite Controller modes PI, PD, PID, Integral wind up and anti-wind up. Response of controllers for different test Input .Selection of control modes for processes like level, temperature and flow.	08
6	CONTROLLER TUNING METHODS: Evaluation criteria IAE, ISE, ITAE etc. process reaction curve method, continuous oscillation method, damped oscillation method, auto tuning.	04
7	FINAL CONTROL ELEMENTS: Pneumatic control value, construction details and types, value sizing, selection of control valves, Inherent and Installed characteristics valve actuators and positioners.	05
8	ADVANCED CONTROL SYSTEM: Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, Interaction of control loops.	05
9	CASE STUDY: Distillation column, Basic features of composition control schemes. Control of overhead composition, Bottom composition and both product compositions, Location of sensing element, Control of columns with varying feed rates, Pressure control, Control of feed temperature and internal reflux control, boiler drum level control.	08
	Total	42

6EI4-05: Neural Networks And Fuzzy Logic Control

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	NEUROPHYSIOLOGY: Introduction: Elementary neurophysiology – From neurons to ANNs - Neuron model McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks. Applications Of Neural Networks: Pattern classification, Associative memories, Optimization, Applications in Image Processing-Iris, finger print & face, Applications in decision making.	06
3	THE PERCEPTRON: The Perceptron and its learning law. Classification of linearly separable patterns. Linear Networks: Adaline - the adaptive linear element. Linear regression. The Wiener-Hopf equation. The Least-Mean-Square (Widrow-Hoff) learning algorithm. Method of steepest descent. Adaline as a linear adaptive filter. A sequential regression algorithm. Multi-Layer Feedforward Neural Networks: Multi-Layer Perceptrons. Supervised Learning. Approximation and interpolation of functions. Back-Propagation Learning law. Fast training algorithms. Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Nettalk.	10
4	FUZZY LOGIC: Introduction -Uncertainty & precision, Statistics and random process, Uncertainty in information, Fuzzy sets and membership. Membership Functions: Features of membership function. Standard forms and boundaries, Fuzzification, Membership value assignment – Intuition, Inference, Neural networks. Fuzzy To Crisp Conversions: Maximum membership principle.	08
5	DEFUZZIFICATION METHODS- Centroid method, Weighted average method, Meanmax membership. Fuzzy Rule Based Systems: Natural language, linguistic hedges, Rule based system –Canonical rule forms, Decomposition of compound rules, Likelihood and truth qualification Aggregation of Fuzzy rules. Graphical techniques of reference.	08
6	FUZZY CONTROL SYSTEM- Simple Fuzzy Logic controller, General FLC, Control System Design Problem Control (Decision) Surface, Assumptions in a Fuzzy Control System Design, Special forms of FLC system models, Industrial application: Aircraft Landing Control Problem. Fuzzy Engineering Process Control: Classical Feedback Control, Classical PID Control, Multi-input, Multi-output (MIMO) Control Systems, Fuzzy Statistical Process Control	08
	Total	41

6EI5-11: Control System Design

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	Design of Feedback Control Systems: Introduction; Approaches to System Design; Cascade Compensation Networks; Phase-Lead Design Using the Bode Diagram; Phase-Lead Design Using the Root Locus; System Design Using Integration Networks; Phase-Lag Design Using the Root Locus; Phase-Lag Design Using the Bode Diagram; Design on the Bode Diagram Using Analytical Methods; Systems with a Pre-filter; Design for Deadbeat Response; Design Examples	10
3	Design of State Variable Feedback Systems Introduction, State space representation of physical systems, State space models of some common systems like R-L-C networks, DC motor, inverted pendulum etc.,.	05
4	Controllable Canonical Form, Observable Canonical Form, Diagonal Canonical Form, State transition matrix, Solution of state equations, Controllability and Observability, Full-State Feedback Control Design; Observer Design; Integrated Full-State Feedback and Observer; Tracking Reference Inputs; Internal Model Design; Design Examples	06
5	Lyapunov's stability and optimal control positive/negative definite, positive/negative semi-definite functions, Lyapunov stability criteria, introduction to optimal control, Riccatti Equation, Linear Quadratic Regulator, Design Examples.	06
	Total	28

6EI5-12: Embedded System Design

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Embedded system architecture and classifications, challenges, choice and selection of microcontrollers for embedded systems design. ARM Processor – Evolution, Architecture versions, Processor Families, Instruction Set – ARM state and Thumb state instructions, Software development tools.	9
3	TIVA ARM Cortex Architecture, Programming: Internal blocks – Processor core features, system peripherals, Memory map, bus system, debug support, User Peripherals, Serial Interfaces, Programming the peripherals using C – examples. Case studies of hardware design and software development.	7
4	OS Concepts and types, tasks & task states, process, threads, inter process communication, task synchronization, semaphores, role of OS in real time systems, scheduling, resource allocation, interrupt handling, other issues of RTOS. Examples of RTOS. Working with TI-RTOS with TIVA ARM Cortex embedded controllers	11
	Total	28

6EI5-13:Robotics

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	01
2	INTRODUCTION- Introduction: Basic concepts, definition and origin of robotics, different types of robots, robot classification, applications, robot specifications	04
3	INTRODUCTION TO AUTOMATION – Components and subsystems, basic building block of automation, manipulator arms, wrists and end effectors. Transmission elements: Hydraulic, pneumatic and electric drives. Gears, sensors, materials, user interface, machine vision, implications for robot design, controllers.	07
4	KINEMATICS, DYNAMICS AND CONTROL- Object location, three dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian work envelope, manipulator dynamics, dynamic stabilization, position control and force control, present industrial robot control schemes.	08
5	ROBOT PROGRAMMING- Robot programming languages and systems, levels of programming robots, problems peculiar to robot programming, control of industrial robots using PLCs.	04
6	AUTOMATION AND ROBOTS- Case studies, multiple robots, machine interface, robots in manufacturing and non-manufacturing applications, robot cell design, selection of a robot.	04
	Total	28

6EI4-21: Electronics Instrumentation Lab

Credit: 2 **Max. Marks: 100(IA:60, ETE:40)**

0L+0T+4P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	Measurement of following parameters of op-amp : (a) Input impedance. (b) Output impedance. (c) Input & Output offset voltage. (d) Input bias currents. (e) Slew rate. (f) Supply voltage rejection ratio (SVRR). (g) Common mode rejection ratio (CMRR). (h) Gain Bandwidth product. (i) Power consumption. (j) Transient response.
3	(a) Differentiator (b) Integrator
4	(a) Wein's Bridge Oscillator (b) RC Phase shift Oscillator
5	Following filters for first order response. (a) High pass filter (b) Low pass filter (c) Notch filter
6	Wave generators – (a) Square wave generator (b) Saw tooth Generator
7	Instrumentation amplifier.
8	A Comparator.
9	(a) Voltage to current converter. (b) Current to voltage converter.
10	Frequency divider
11	Study and make the following circuits on bread board using 555 timer & determine the o/p frequency and Duty cycle: (a) Astablemultivibrator (b) Monostablemultivibrator (c) Bistablemultivibrator

6EI4-22: Control System Simulation Lab

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**
0L+0T+2P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	Introduction to `Matlab'. Computing control software, defining systems in TF, ZPK form.
3	Use of for, while loops in Matlab programming.
4	(a). Plot step response a given TF and system in state-space. Take different valves of damping ratio and natural undamped frequency and observe the difference. (b). Plot ramp and impulse response for the same.
5	For a given 2nd order system write a program to obtain time response specifications maximum overshoot, peak time, settling time etc.
6	Write a program to check for the stability of a given closed loop system by (a) Finding close loop poles (b) using Routh's stability criterion.
7	Sketch the root locus for a given system and determine the system gain. Also simulate the same using MATLAB.
8	Sketch the Bode plot (actual and asymptotic) for a given system and analyses the stability. Also simulate the same using MATLAB and find the values of GM and PM for different values of gain.
9	Design of lead controller to satisfy given specifications using bode plot.
10	Use MATLAB to plot Nyquist plot for a given system and comment upon stability.
11	To design a PID controller for the given system to meet desired specifications. Observe the response using MATLAB.

6EI4-23: Process Control Lab

Credit: 2 **Max. Marks: 100(IA:60, ETE:40)**

0L+0T+4P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	To perform experiments on Linear system simulator.
3	To draw response of temperature controlled process for On/Off, P, PI, PID Controller.
4	Tuning of controllers on a pressure loop.
5	To study the design and application of Lag compensator circuits.
6	To study the design and application of Lead compensator circuit.
7	To study process simulator. (a) To perform experiments on P, PI, PD, PID controller with Process simulation. (b) To study the effect of loading the process.
8	To study the operation of linear & equal percentage type control valves and determine the Following:- (i) Valve flow coefficient (ii) characteristics of control valve (iii) Rangeability of control valves.
9	To perform experiments on Ratio Control Scheme and Cascade Control Scheme on liquid level and flow system.
10	To plot and analyze step/impulse response of a first order system in (i) Non interacting mode (ii) Interacting mode.
11	(a) Study of basic logic operations, timer, counter, arithmetic operations in PLC. (b) Problem solving In PLC. (c) To perform experiments on PLC controlled process.

6EI4-24: Power Electronics Lab

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P **End Term Exam: 2 Hours**

SN	Contents
1	Introduction: Objective, scope and outcome of the course.
2	Study the characteristics of SCR and observe the terminal configuration, measure the breakdown voltage, latching and holding current. Plot V-I characteristics.
3	Perform experiment on triggering circuits for SCR. i.e. R triggering, R-C triggering and UJT triggering circuit.
4	Study and test AC voltage regulators using triac, anti parallelthyristors and triac&diac.
5	Study and obtain the waveforms for single-phase bridge converter.
6	Perform experiment on single phase PWM inverter.
7	Perform experiment on buck, boost and buck-boost regulators.
8	Control speed of a dc motor using a chopper and plot armature voltage versus speed characteristic.
9	Control speed of a single-phase induction motor using single phase AC voltage regulator.
10	(i) Study single-phase dual converter (ii) Study speed control of dc motor using single-phase dual converter
11	Study single-phase cyclo converter.
12	Perform experiment on Motor control – open loop & closed loop.
13	Design, observe and perform experiment on various type of pulse generation from DSP/ FPGA platform. Perform experiment for PWM inverters and choppers.