Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. V Semester

Electronics Instrumentation & Control

Rajasthan Technical University, Kota

Effective from session: 2025-26

5EI3-01: Digital Signal Processing

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**
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: 100(IA:30, ETE:70)**

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: 100(IA:30, ETE:70)**

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:30, ETE:70)**

2L+0T+0P **End Term Exam: 3 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: 100(IA:30, ETE:70)**

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:30, ETE:70)**

2L+0T+0P **End Term Exam: 3 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:30, ETE:70)**

2L+0T+0P **End Term Exam: 3 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:30, ETE:70)**

2L+0T+0P **End Term Exam: 3 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: 100(IA:60, ETE:40)**
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: 100(IA:60, ETE:40)**
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: 100(IA:60, ETE:40)**
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.