SunRise University

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Syllabus & Scheme for

M.Tech. (Electronics Instrumentation Engg.)

Department of Electronics Engineering

SRU University of Science & Technology, ALWAR

(RAJASTHAN)

M. Tech. (Electronics Instrumentation Engg.) Scheme

First Semester

Subject Code	Subject Title	Credit (L-T-P)		Marks Weightage	
				Theory	Sessional
1MTEI01	Modern Control System	4	4-0-0	60	40
1MTEI02	Industrial Process Control	4	4-0-0	60	40
1MTEI03	Industrial Electronics	4	4-0-0	60	40
1MTEI04	Optimization Technique	4	4-0-0	60	40
				External	Internal
1MTEI05	Control and Computation Lab	1	0-0-2	20	30
1MTEI06	Modelling and Simulation Lab	1	0-0-2	20	30
	Total	18	16-0-4	280	220

Second Semester

Subject Code	Subject Title	Credit (L-T-P)		Marks Weightage	
				Theory	Sessional
2MTEI01	Non Linear Control System	4	4-0-0	60	40
2MTEI02	Optimal Control System	4	4-0-0	60	40
2MTEI03	Electronics Instrumentation	4	4-0-0	60	40
2MTEI04	Elective -I	4	4-0-0	60	40
				External	Internal
2MTEI05	Advance Microprocessor and Microcontroller Lab	1	0-0-2	20	30
2MTEI06	Industrial Electronics Lab	1	0-0-2	20	30
2MTEI07	Seminar	1	0-0-2	--	50
	Total	19	16-0-6	280	270

Third Semester

Subject Code	Title	Credit (L-T-P)		Marks Weightage	
				Theory	Sessional
3MTEI01	Computer Control of Process	4	4-0-0	60	40
3MTEI02	ANN and Fuzzy Control	4	4-0-0	60	40
3MTEI03	Stochistic Control	4	4-0-0	60	40
3MTEI04	Elective-II	4	4-0-0	60	40
				External	Internal
3MTEI05	Minor Project	6	0-0-8	120	180
	Total	22	16-0-8	360	240

Fourth Semester

Subject Code	Title	Credit	(L-T-P)	Marks Weightage	
				Theory	Sessional
4MTEI01	**Dissertation**	**12**	**0-0-24**	**200**	**300**
	Total	**12**	**0-0-24**	**200**	**300**

***The student will have to select subject from list of elective as under**

List of Elective

Elective –I

1. Microprocessor based Control System
2. Digital Signal Processing
3. Reliability Engineering

Elective – II

1. Robotics and Automation
2. Biomedical Instrumentation

E-601 C MODERN CONTROL SYSTEM

State Variable Analysis – Introduction, vectors and matrices, state variable representation, conversion of transfer function model to state variable model, conversion of state variable model to transfer function model, decomposition of transfer function into canonical state variable models, Eigen values and Eigen vectors, solution of state equations. Concept of controllability and observability, equivalence between transfer function and state variable representation.

Discrete time system and Z transform methods – Introduction to discrete time system**,** the Z transform, solution of difference equations, inverse Z transform, pulse transfer function, Stability analysis in Z plane.

State variable analysis of discrete time system – state space analysis of linear discrete time system, controllability and observability, multivariable system.

Pole placement and state observers – introduction, stability improvement by state feedback, necessary and sufficient condition for arbitrary pole placement, state regulator design, design of state observers, state feedback with integral control, digital control system with state feedback.

Text books –

1. Control System by B. C. Kuo.
2. Digital and non linear control by M. Gopal
3. Control System by Nagrath and Gopal.

E 603 C Industrial Process Control

Historical prospective, incentives of process control, synthesis of control system, classification and definition of variables.

Need and application of mathematical modeling, lumped and distributed parameters, analogies, thermal, electrical and chemical systems, modeling of CSTR, heat exchanger, interacting and non interacting type of systems, dead time elements.

Control modes, definition, characteristics and comparison of P, PI, PD, PID controllers.

Dynamic behavior of feedback controlled process for different control modes, control system quality, IAE, ISE, IATE criterion, tuning of controllers, Ziegler-Nicholos and Cohen coon methods.

Realization of different control modes in electric and electronic controllers.

Control valves, types, function, hydraulic, pneumatic actuators, solenoid, stepper motors.

Review and limitation of single loop control, need for multi loop systems.

Principle, analysis and application of cascade, ratio, feed forward, feedback, override, split range, selective, auctioneering control.

Introduction to adaptive and self tuning control.

Interaction and decoupling of loops.

Text Books-

1. George Stephnopolous “Chemical Process Control” Prentice Hall
2. Peter Herriot, “ Process control” Tata McGraw Hill
3. Donald R caughanowr “ Process System Analysis and control” McGraw Hill international edition.
4. D.P.Eckmen “ Industrial instrumentation” Wiley Eastern.

E 605 C Industrial Electronics

Unit I. Industrial Solid State Devices :SCR, ASCR, RCT, Triac, Diac, Unijunction Transistor, SUS, SBS, Power MOSFETs, MCT, Static Induction Devices

Unit II. Industrial Converter and Regulated Power Suppliers: Single phase, three phase and six phase controlled rectifiers and their performance , dual converters, single phase and three phase ac regulators.

Unit III. Industrial Choppers: Chopper classification, chopper operation, control strategies, chopper configuration, thyristor chopper circuits, Jones chopper, Morgan chopper, Multiphase chopper

Unit IV. Industrial Invertors : Requirement of practical inverters - Types of inverters - Single phase inverters using Thyristers -Ability to operate into inductive load - Overcurrent protection - Output. Voltage control - waveform control Typical inverter circuits - Three phase inverters.

Unit V. Industrial Process Control and applications :

(a) Resistance welding controls - Resistance Welding process - Basic circuit for A.C. resistance Welding - Types of resistance Welding - Electronic Welding Control.
(b) Induction heating - basic Principle - Theory - Applications - High frequency Power Source for Induction heating.
(c) Dielectric heating - basic Principle - Theory - Applications - Electrodes used in Dielectric heating - Method of Coupling of Electrodes to the R.F. Generator - Thermal losses in Dielectric heating.
(d) UPS, SMPS

Text Books

1. Industrial Electronics - G.K. Mittal
2. Industrial Electronics - Noel Morris
3. Power Electronics- Ned Mohan, Wiely Eastern Publication
4. Power Electronics –C.W.Lander, McGraw Hill

E 607 C Optimization Techniques

Introduction –

Optimization concepts, Euclidean space, convex functions, gradient vector, Hessian matrix, formulation of engineering problems amenable to optimization, direct approach and indirect methods.

Classical optimization techniques –

maxima minima for functions of several variables, necessary and sufficient conditions, formulation of non linear optimization problems with equality and inequality constraints, solution techniques using Lagrange's multiplier and khun-tuckker conditions.

Uni dimensional optimization –

Elimination methods, interpolation methods.

Multivariable optimization –

Concepts of Hill climbing, methods of steepest descent, Newton Raphson methods, Fletcher power method, constrained optimization.

Other techniques –

principle of optimality, solution for simple multistage problems, Dynamic Programming, Geometric Programming.

Books:

S. S. Rao, "Optimization Techniques" -

E 602 C Non linear Systems

Describing function analysis of non linear control systems –

Introduction to non linear system, nonlinear control system, Describing functions, describing function analysis to non linear control systems**.**

Phase plane analysis -

Introduction, methods of constructing trajectories, obtaining time solutions from phase plane plots, singular points, phase plane analysis of linear control systems, phase plane analysis of nonlinear systems.

Liapunov stability Analysis –

Introductions, definitions, second method of liapunov, stability analysis of linear system, stability analysis of non linear systems, estimating the time response behavior of dynamic system, methods to formulate liapunov function.

Text Books:

K Ogatta, “Control System Theory”

Gibson, “Non Linear Control System”

M. Gopal “ Discrete and non linear system”

E 604 C Optimal Control Theory

Introduction –

Introduction, optimal control system, performance indices, Formulation of optimization problems, time optimal control systems.

Controllability –

Linear independence, complete state controllability of continuous system, complete state controllability of discrete system, alternate form of the conditions of complete state controllability, out put controllability.

Observability –

complete state Observability of continuous system, complete state Observability of discrete system, alternate form of the conditions of complete state Observability, Principle of duality.

Time Optimal Control System –

Time optimal control for continuous time system with bounded control signals, time optimal control for discrete time system.

optimal control system based on quadratic performance indices. Calculus of variations, applications of optimal control to dynamic systems. Pontryagin minimum principle and its application to optimal control problems with constraints, Dynamic Programming, Bellman- Jacobi equation and its applications, introduction to optimal control of distributed parameter system. Solution algebraic Ricattii's equation for linear regulator problem.

Text Books:

A.J.Kirk, "Optimal Control Theory"

M. Gopal, "introducing Optimal Control System"

M. Gopal, "Descrete and Non Linear system"

Nagrath And Gopal, "Control System"

K.Ogatta, Modern Control System

E707C1 Robotics and Automation

Fundamentals: historical information, robot components, robot characteristics, robot anatomy, basic structure of robots, resolution, accuracy and repeatability

Robot Kinematics: Position Analysis forward and inverse kinematics of robots, including frame representations, transformations, position and orientation analysis, and the Denavit-Hartenberg representation of robot kinematics, the manipulators, the wrist motion and grippers. Examples- Kinematics analysis and inverse kinematics analysis of four axis, five axis and six axis robot

Differential motions, Inverse Manipulator Kinematics: differential motions and velocity analysis of robots and frames

Dynamic Analysis and Forces analysis of robot dynamics and forces. Lagrangian mechanics is used as the primary method of analysis and development

Trajectory Planning methods of path and trajectory planning, both in joint-space and in Cartesian-space Actuators and Sensors actuators, including hydraulic devices, electric motors such as DC servomotors and stepper motors, Pneumatic devices, as well as many other novel actuators. It also covers microprocessor control of these actuators, mechatronics. Tactile sensors, proximity and range sensors, force and torque sensors, uses of sensors in robotics

Robot Programming , Systems and Applications: Robot languages, Method of robots programming, lead through programming methods, a robot programs as a path in space, motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitation of lead through methods and robotic applications

Fuzzy Logic Control: Basic principles of fuzzy logic and its applications in microprocessor control and robotics.

Recommended Books

1. Gonzalez, R. C., Fu, K. S. and Lee, C.S.G., Robotics Control Sensing, Vision and Intelligence, McGraw Hill (1987).
2. Koren,Y., Robotics for Engineers, McGraw Hill (1985).
3. Niku, S.B., Introduction to Robotics, Analysis, Systems, Applications, Dorling Kingsley (2006).
4. Predko, M., Programming robot controllers, McGraw Hill (2002).

E 606 C Electronic Instrumentation

Unit1

Error Analysis: Types of errors, Methods of error analysis, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi-Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting, Graphical analysis, rejection of data.

Unit II

Static and Dynamic characteristics: Dynamic analysis of instrumentation system, Relative merits of analytical and experimental modeling of dynamic behavior, Response of zero, first and 2nd order system to step, Pulse, Harmonic and random test signals, Frequency spectra, Auto correlation spectral density, Loading effects under static and dynamic conditions, Simulation of dynamic response.

Unit III

Classification, selection of transducers, Resistance, inductance and capacitance type of transducers, measurement of displacement, strain, force, liquid level, pressure, velocity and acceleration.

Unit IV

Measurement of low, medium, and high resistance, A.C. Bridges, Measurement of inductance and capacitance, R.L.C. Measurement, DeSauty's, Maxwell's, Anderson's, Schering and Campbell's bridges, errors in bridge measurements.

Unit V

Radioactive instrumentation and Refractometry

a) X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law, Auger emission spectroscopy, Electron spectroscopy for chemical analysis (ESCA).
b) Radiation detectors: Ionization chamber, Geiger-Muller counter, proportional counter, scintillation counters
c) Refractometry: Principle, Abbe and Differential refractometer

UNIT VI

Methods of Data transmission, General telemetry systems, DC and AC telemetry system. Modulation, Pulse telemetry systems, Digital telemetry.

UNIT VII

Graphic Recorders: Graphic analog recorder, magnetic tape analog recorders, oscillograhic analog recorders, digital recorders

Text Books:

1. Instrumental Methods of Analysis, Willard, Merritt, Dean, Settle, CBS Publishers & Distributors, New Delhi, Seventh edition.
2. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company.
3. Principles of Instrumental Analysis, Skoog, Holler, Nieman, Thomsonbrooks-cole publications, 5th edition.
4. Electrical Measurement & Measuring Instruments E.W.Golding
5. Electrical Measurement A.K.Sawhney

E701 C COMPUTR CONTROL OF PROCESS

UNIT I: Computer control-Introduction-Review of z transform, modified Z transform and Delta transform Relation between discrete and continuous transfer function –poles and Zeroes of Sample data system (SDS)- Stability Analysis in Z domain .

UNIT II: Introduction to Pulse Transfer function –Open loop and closed loop response of SDS design and implementation of different digital control algorithm: Dead beat, Dahlin and internal Model Control algorithm with Examples

UNIT III: Different model of discrete System: LTI System: - Family of Discrete transfer function. Model-State space models:-Distributed parameter model. Models for time varying and non-linear system: linear time varying model, non-linear state space models, non-linear black box models-Fuzzy models

UNIT IV: Parameter Estimation methods: General principles – Minimising Prediction errors-Linear Regression and the Least Square method –Statistical frame work for Parameter estimation and the maximum likely hood method –instrument variable method- recursive and weighted Least square method.

UNIT V: Adaptive control: Introduction –Deterministic self Tuning Regulated: Indirect and direct self tuning regulator. Model reference Adaptive system: Design of MRAC using Lyapnovand MIT rule – auto tuning gain scheduling adaptive control design with examples

Text book

1. Lennart ljung- system Identification. Theory for The user-PTR Prentice Hal Information and system sciences series, NJ, 1999

2. P. Deshponde and ash, computer controlled system ISA Press, USA

3. Richard H. Middieton Graham Goowin‘ Digital control and estimation A unified Approach ‘prentice Hall NJ, 1999

4. Dale E. Seborg, Thomas F Edgar, Duncan mellichamp,”Process Dynamics and control” Willey India 2006

5. Astrom A.J,Bjorn Witten mark ,Adaptive Control, Second Edition ,Prentice Hall of india , New Delhi, 1994

E703 C Artificial Neural Network and Fuzzy Control

Unit 1

Introduction, Neural network characteristics, history of development of neural network principles, artificial neural net terminology, models of neuron, topology.

Unit 2

Learning methods and neural network models, types of learning, supervised, unsupervised, reinforced learning, knowledge, representation and acquisition, Basic Hopfield model, basic learning laws, unsupervised learning, competitive learning, Kmeans clustering algorithm. Kohnen's feature maps.

Unit 3

Artificial neural networks – Radial basis function neural networks, Basic learning laws in REF nets, Recurrent back propagation, introduction to counter propagation networks, CMAC networks and ART networks.

Unit 4

Applications of neural nets, applications such as pattern recognition, pattern mapping, Associative memories, speech and decision making.

Unit 5

Fuzzy logic Basic concepts of fuzzy logic, fuzzy Vs crisp set, linguistic variables, membership functions, fuzzy sets and operations on fuzzy sets, IF-Then rules, variable inference techniques, De-fuzzyfication. Basic fuzzy inference algorithm, Fuzzy system design, antilock breaking system, industrial applications.

Text Books:

B. Yagnanarayana, "Artificial neural networks" PHI

Z. M. Zurada, "Introduction to artificial neural systems" Jaico Publications

Ross J.T."fuzzy logic with engineering applications"

E 705 C Stochastic Processes

1. Introduction
   Overview of stochastic process, limitation of deterministic control and processes.
2. Probability and axioms
   Definitions, axioms and probability, conditional probability.
3. Repeated Trails
   Combined experiments, Bernoulli trails, asymptotic theorems, poison theorem, Bay's theorem and statistics.
4. Random Variables
   Distribution and density function, conditional distributions, total probability and Bay's theorem, mean and variance, moments characteristics functions, two random variables, moments and conditional statistics.
5. Stationary processes, system with stochastic inputs, Periodicity, , correlation and spectra.
   Text Books
   Populis, "Probability, Random Variables and stochastic process" McGraw Hill

E-608 C2 Digital Signal Processing

Unit 1

Classification of signals, concept of frequency in continuous time and discrete time signals A/D, D/A conversion i.e. sampling and quantization. Classification of discrete time systems, introduction to IIR and FIR systems.

Unit 2

Analysis of discrete time linear time invariant system, techniques for the analysis of linear systems, convolution sum, properties of convolution and the interconnection of LTI systems, stability of LTI systems, difference equations to describe LTI systems, impulse response of LTI system.

Unit 3

Z transformation, ROC, Properties of Z transformation, rational Z transformation, one sided Z transformation, solution of difference equation, basic network structure of IIR system, direct form cascade form, parallel form, basic network structure of FIR system, DFT and its properties, fast fourier transform (FFT), decimation in time algorithm, decimation in frequency algorithm, design of IIR filter by bilinear transformation, design of FIR using windows, properties of FIR filters.

Unit 4

Lionear prediction and optimum linear filters-forword and backword linear prediction, Levinson-Durbin algorithm, Schur algorithm, AR and ARMA model, Wiener Filter- FIR, IIR, non casual (speech recognition application)

Unit 5

Effects of finite register lengths in digital signal processing, effects of truncation and rounding, finite register length effects in realization of digital signal IIR filter, statistical analysis of quantization in floating point realization of IIR filters, finite register length effects in realization of FIR filters, statistical analysis of quantization in fixed point realization of FIR filters, statistical analysis of quantization in floating point realization of FIR filters.

Text Books:

1. Alan V. Oppenhelm/ Ronald. W. Schafer, Digital Signal Processing, Pearson Education.
2. John G. Prokis & Dimities G. Manolakis, Digital Signal Processing, PHI, 1998.
3. Dimities G. Manolakis, Vinay K.Ingale & Stephen M Kogon, Statistical and Adaptive Signal Processing, McGraw Hill International Education

E-608 C3 Reliability Engineering

Unit 1

Basic Definitions, concept and need for reliability, inherent value of reliability in modern systems, hazard rate, failure density function, mean time to failure and repair, relationship between basic variables, analytical form of reliability function, derivation for exponential distribution function, other kind of distribution

Unit 2

Different types and modes of failure, causes of failure in different systems, systems structures, series, parallel, standby, k-out-off-n configuration, their reliability analysis

Unit 3

Reliability evaluation techniques applicable to general non series parallel systems, Marko processes for repairable and non repairable systems and their applications in reliability analysis, faults and digital circuits, use of TMR and multiplex TMR.

Unit 4

Methods to improve reliability, quality control, derating, debugging, environmental control, use of various kinds of redundancy etc.

Unit 5

Reliability optimization- various methods, redundancy allocation, the trade off between reliability and cost.

Unit 6

Reliability allocation, reliability testing methods, maintenance, distinction of repair and maintenance, analysis of simple maintenance policies, system diagnostic, fault free analysis, top down and bottom up approach, diagnostic charts

Text Books

1. L.S.Srinath, Concepts of Reliability
2. Ballaguruswamy, Reliability Engineering

E707 C2 Bio Medical Instrumentation

Unit 1

Introduction, general block diagram of bio medical instrumentation system, origin of bio electric signals, recording systems, preamplifiers, main amplifiers and transducers used for medical instrumentation system, types of recorders

Unit 2

Biomedical recorders and display systems-ECG, EEG,EMG, electrodes used for ECG, EEG and EMG, oscilloscopes used for bio medical measurement, multi channel display

Unit 3

Blood gas analyzer- blood pressure measurement, patient monitoring systems, blood pH measurement, blood PO_2 , PCO_2, complete blood gas analyzer

Unit 4

Special machines- X ray machine, MRI, ultrasonic imaging systems, A-scanner, B-scanner, echo cardiograph

Unit 5

Cardiac pacemakers and defibrillators- external pace maker, implanted pace maker, programmable pace maker, DC defibrillators, implantable defibrillators

Unit 6

Laser applications in bio medical field- ruby laser, argon laser, helium neon laser, CO_2 laser, Na-yag laser

Text Books

1. R.S.Khandpur, " Introduction to bio medical Instrumentation"
2. Cromwell, "Bio medical Instrumentation"

E707 C2 Bio Medical Instrumentation

Unit I

Characteristics of Transducers and Electrodes for Biological Measurement: Introduction to human body; block diagram, classification, characteristics, Various physiological events and suitable transducer for their recording, Bioelectric potentials.

Unit II

Cardiac System: Cardiac musculature, Electro cardiography, ECG recording, Phonocardiography, holter recoding ECG lead system, Heart rate meter, vector cardiography, Pacemakers, Defibrillators.

Unit III

Blood Pressure and Blood Flow Measurement: Invasive and non-invasive methods of Blood pressure, Characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography.

Unit IV

Respiratatory System: Mechanics of breathing, Parameters of respiration, Respiratory system measurements, Respiratory therapy instruments.

Unit V

Muscoskeletal systems: EMG, Clinical applications, Muscles stimulator.

Unit VI

Instrumentation for Measuring Nervous Function: EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET.

Unit VII

Clinical Laboratory Instrumentation: Test on blood cell, Blood cell counter, Blood glucose monitors, auto analyzer, Pulse-oximeter.

Unit VIII

Recent Trends in Biomedical Engg.: Patient care and monitoring, Non-invasive diagnostic instrumentation, Biotelementry, Telemedicine, Prosthetic devices, Lie detector test, Application of lasers and ultrasonic in biomedical field.

Unit IX

Troubleshooting & Electrical Safety of Biomedical Instruments: Physiological effect of current and safety measurement.

Text Books

1. R.S.Khandpur, " Introduction to bio medical Instrumentation"
2. Cromwell, "Bio medical Instrumentation"