DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. ACAD/SU/B.E./Syllabi/95/2014

It is hereby informed to all concerned that, the syllabus prepared by the Boards of Studies, Ad-hoc Board, Committees and recommended by the Faculty of Engineering and Technology, the Academic Council at its meeting held on 08-07-2014 has accepted the following **"Revised Syllabi for all Branches of [B.E.]"** as appended herewith :-

Sr.No.	Revised Syllabi
[1]	B.E. Civil Engineering,
[2]	B.E. Mechanical Engineering,
[3]	B.E. Electrical Engg. / EEP / EE/EEE.,
[4]	B.E. Computer Science & Engineering,
[5]	B.E. Information Technology,
[6]	B.E. ECT/EC/E&C/I.E,
[7]	B.E. Instrumentation & Control / Instrumentation,
[8]	B.E. Biotechnology,
[9]	B.E. Chemical Engineering.

This is effective from the Academic Year 2014-2015 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. ACAD/ SU/ B.E/
SYLLABI / 2014/
A.C.S.A. I.No.447[03].

Date:- 13-08-2014.

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Director,
Board of College and
University Development.

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Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.

2] The Director, University Network & Information Centre, UNIC, with **a request to upload the above all syllabi on University Website.**

Copy to :-

1] The Controller of Examinations,

2] The Superintendent, [Engineering Unit],

3] The Programmer [Computer Unit-1] Examinations,

4] The Programmer [Computer Unit-2] Examinations,

5] The Superintendent, [Eligibility Unit] ,

6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,

7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

B.E.

INSTRUMENTATION & CONTROL / INSTRUMENTATION

UNDER THE FACULTY OF ENGINEERING & TECHNOLOGY.

[Effective from 2014-15 & onwards]

Following shall be scheme of Instructions and examination for BE (Instrumentation and Control / Instrumentation) Rev. Academic year 2014-15.

Subject No.	Subject	Teaching scheme HRS/WEEK			Examination scheme					Duration of theory paper hrs
		Th.	Pr.	Total	Theory	Term work	Pract.	Class test	Total	
	Part - I									
ICE 4701	Modern Control Theory	4	2	6	80	25	25	20	150	3
ICE 4702	Process Modeling and Optimization	4	2	6	80	25	25	20	150	3
ICE 4703	Operating System and Networking	4	2	6	80	25	25	20	150	3
ICE 4704	Biomedical Instrumentation	4	2	6	80	25	25	20	150	3
ICE 4705	Elective:1	4	-	4	80	-	-	20	100	3
ICE 4706	Project Design- I	-	2	2	-	50	-	-	50	-
	Total of part- I	20	10	30	400	150	100	100	750	-
	Part – II									
ICE 4707	Digital Control System	4	2	6	80	25	25	20	150	3
ICE 4708	Project Engineering and Management	4	2	6	80	25	25	20	150	3
ICE 4709	Instrument System Design	4	2	6	80	25	25	20	150	3
ICE 4710	Elective:2	4	-	4	80	-	-	20	100	3
ICE 4711	Project: II	-	2	2	-	50	100	-	150	-
ICE 4712	Control system Lab	-	2	2	-	50	-	-	50	-
	Total of part - II	16	10	26	320	175	175	80	750	-
	Grand total of part I & II	36	20	56	720	325	275	180	1500	-

Ele: 1: 1.Advanced control system
2. Robotics
3. Neural and fuzzy based control system
4. Open Elective

Ele: 2: 1. Automotive Instrumentation
2. Building Automation and Security System
3. VLSI Design.

Note: Following rules are to be follow strictly where ever are applicable.

1. Term Work: Term work shall consist of at least eight assignments/experiments based on the above syllabus. Some of them may be from the above indicated list. Student should submit a journal consisting of the record of experiments performed as indicated above.

2. Practical Examination: The practical examination shall consist of performing the experiments/assignments based on the practical work done during the course, the record of experiments/assignments submitted by the candidate and viva-voce based on the syllabus.

3. Theory Examination:

Pattern of Question Paper:

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section. Question paper should cover the entire syllabus.

For Theory paper 80 marks:

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.
4. Two questions from remaining questions from each section be asked to solve having weight age of 15 marks

PART I

ICE 4701: MODERN CONTRL THEORY

Teaching Scheme
Lectures: 4 Hrs/week
Practical: 2 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1:
Mathematical Preliminaries: Linear vector spaces and linear operators: Fields, vectors and vector spaces, Linear dependence, Dimension of linear space, The notion of bases, Linear transformation and matrices, Scalar product and norms, Quadratic function and definite matrices, vector and matrix norms, Gram determinant, Solution of linear algebraic equation: Range space, Rank, Null space and nullity of a matrix, Homogenous and non homogeneous equations, Eigen values and Eigen vectors and a canonical form representation of linear operators, Functions of square matrix: Caley-Hamilton theorem (08)

Unit 2:
State variable method and design of linear systems: Concept of state, state variable, and state model, state space representation using physical, phase and canonical variables and their block diagram representation, state model and transfer function, digitalization, solution of state equation, state transition matrix its properties and computation, **(06)**

Unit 3:
Controllability and Observability: and their test criterion, pole placement design using state feedback, state observer, reduced order and full-order observer design, Design of control systems with observers, Design of servo system, (06)

Unit 4:
Introduction to Optimal Control systems, Linear Quadratic regulator (LQR): Theory and Design. Lyapunov stability test. (06)

Unit 5:
Non-linear system analysis: Behavior of non linear systems, common physical nonlinearities, describing function method, concept derivation of describing function method, phase plane method, singular points, stability of non linear system, construction of phase trajectories by isocline's method, nonlinear system analysis by phase plane method. (08)

Unit 6:
System uncertainties and disturbances: Effect of uncertainties and disturbances on system performance, uncertainty and disturbance estimation, Effect of uncertainties and disturbances on controller and observer design, effect of measurement noise and un- modeled dynamics. **(06)**

Text Books

1. "Modern Control Engineering", K. Ogata, Pearson education India.
2. "Discrete Time Control systems", K. Ogata Prentice Hall of India.
3. "Digital Control and State Variable Method" M. Gopal, Tata McGraw Hill.
4. "Control System Engineering", Norman Nise,Wiley India, Fifth ed., 2009.

Reference Books

1. "Automatic control systems", B. C. Kuo, Prentice Hall of India.
2. "Control systems engineering", Norman S. Nise, John Wiley and sons, Inc, Singapore.
3. "Digital control of Dynamic Systems", J. David Powell, Michael Workman, G. F.Franklin, Addison Wesley.
4."Control System Design",G. C. Goodwin, S. F. Graebe, M. E. Salgado; PHI, First ed. 2002.
5."Control System Design", Friedland, Dover Publication, First ed., 2005.

List of Experiments: The following experiments may be performed using software/ hardware

1. To obtain state model of a given transfer function and vice-versa.
2. To obtain state transition matrix of a given continuous time system.
3. To investigate controllability and observability of a given system.
4. To investigate the stability of continuous and discrete time systems using Lyapunov stability test.
5. To obtain state feedback gain matrix for pole placement.
6. To obtain the range of gain for the stability of discrete time system.
7. To obtain impulse and step response of discrete time control systems
8. To obtain the range of sampling time for the stability of discrete time system

ICE 4702: PROCESS MODELING AND OPTIMIZATION

Teaching Scheme
Lectures: 4 Hrs/week
Practical: 2 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1

Mathematical models of Chemical systems

A. Applications of mathematical models and principles of formulation, Fundamental laws: Continuity equations, Energy equation, Equations of motion, Examples of models: Modeling of CSTR's (isothermal, non-isothermal, constant holdup, variable holdup),Batch reactor, Ideal binary distillation column, Heat exchanger, Boiler, Field controlled and Armature controlled D.C. Motors.
B. Types of models, Equations of state, Equilibrium, Chemical kinetics. (08)

Unit 2

Numerical methods for solving algebraic and differential equations and curve fitting

A. Solution of algebraic equations: Interval halving method, Newton Raphson method Solution of differential equations: Euler method, Modified Euler method, Runge Kutta methods (2nd and 4th order), Adam Bashforth method.Curve fitting: Lagrange interpolation method, Least squares method.
B. Vapor-liquid equilibrium bubble point calculation problem. (06)

Unit 3

Computer simulation of chemical and physical systems

A. Gravity flow tank, three isothermal CSTR's in series, non-isothermal CSTR, Batch reactor, Ideal binary distillation column, First and second order electrical systems.
B. Explicit convergence methods. (06)

Unit 4

Basic concepts of optimization and unconstrained optimization

A. Continuity of functions, Concave and convex functions, Unimodal and Multimodal functions, Necessary and sufficiency condition for an extremum of an unconstrained function. Unconstrained single-variable optimization: scanning and bracketing procedures.Numerical methods: Newton, Quasi Newton and Secant methods. Unconstrained Multivariable optimization:Direct methods: Conjugate search directions, Powell's method.Indirect methods: Gradient methods, Conjugate gradient method, Newton's method.
B. Fibonacci method, Golden section method. (08)

Unit 5

A. Linear and nonlinear programming

A. Linear programming: Degeneracies, Graphical method, Simplex method, Sensitivity analysis, Karmarkar algorithm. Nonlinear programming: Lagrange multiplier method, Quadratic programming.
B. Generalized reduced gradient method. (06)

Unit 6

A. Process Identification: Purpose, time domain fitting of step test data, sine wave testing, pulse testing, step testing and on-line identification.
B. Optimization Techniques and applications: Single and multivariable optimisation, line programming, sequential, quadratic programming and reduced gradient optimization techniques and applications. Introduction to geometric programming and dynamic programming. (06)

Text Books

1. "Process, Modeling, Simulation and Control for Chemical Engineers", W. L. Luyben,McGraw Hill.
2. "Optimization of Chemical Processes", T.F.Edgar, D.M.Himmelblau, McGraw Hill.
3. "Advanced Practical Process Control", B.Roffel, B.H.L.Betlem, Springer.

Reference Books

1. "Higher Engineering Mathematics", B. S. Grewal, Khanna Publications.
2. "Practical Process Instrumentation and Control", J. Malley, McGraw Hill.
3. "System Simulation with digital Computer", Deo Narsingh, Prentice Hall India

List of Experiments: The following experiments may be performed using software/ hardware

1. Mathematical modeling and simulation of single tank process.
2. Mathematical modeling and simulation of interacting tank process
3. Mathematical modeling and simulation of non-self regulating system
4. Mathematical modeling of stirred tank heated system
5. Model identification of level loop
6. Model identification of flow loop.
7. Model identification of heat exchanger.
8. Study of advance control techniques.

ICE 4703: OPERATING SYSTEM AND NETWORKING

Teaching Scheme
Lectures: 4 Hrs/week
Practical: 2 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1
Introduction to the principles of operating systems and concurrent programming. Operating system services, file systems and organization, resource management, synchronization. Memory management, I/O subsystem. The concept of a process; process cooperation and interference. Introduction to networks, and protection and security. (06)

Unit 2
Linux: An Overview of Red Hat/Fedora Core Linux, Installing Red Hat/Fedora Core Linux, Getting to Know Red Hat Linux, Working with the Desktop, Accessing and Running Applications, Publishing with Red Hat Linux, Multimedia in Red Hat Linux, Tools for Using the Internet and the Web, Understanding System Administration Setting Up and Supporting Users Automating System Tasks Backing Up and Restoring Files Computer Security Issues. (08)

Unit 3
Introduction to Real-Time /Embedded Operating Systems. Real Time Scheduling, Performance Metrics of RTOS, Linux &RT Linux Internals, Programming in Linux &RT Linux, Configuring& Compiling RT Linux, Overview of other RTOS/EOS. (06)

Unit 4
Introduction to computer networks and transmission media: - Types of networks, topologies, centralized and distributed networks, Overview of wireless networks, Internet, Design Issues, Layered architecture, Protocols. Overview of network models -ISO OSI and TCP/IP. Physical Layer:-Max data rate of Channel, Transmission media guided and unguided and their types with specifications; Modems and Protocols used; Multiplexing techniques; Circuit switching, Message Switching, Packet switching networks; Cable TV and Internet over Cable. (08)

Unit 5
Data link layer (LLC and MAC sub layer):- Framing, Error control, Flow control, Simplex Stop and Wait Protocol, Sliding Window Protocols, Data Link layer in Internet, HDLC, PPP, SLIP, Static and Dynamic Channel Allocation in LAN, CSMA/CD Protocols, Collision free protocols, WDMA protocol, IEEE 802 standards for Ethernet, token bus and token ring, DQDB. Bridges, High speed LAN's (Fast Ethernet, gigabyte Ethernet and FDDI) (06)

Unit 6
Network Layer and Transport Layer:- Virtual Circuits and Data gram networks, Circuit switching and Packet Switching ,Routing Algorithms, Routers and Routing Protocols, Congestion Control and Algorithm (Issues like delay, load, throughput, jitter etc), IP layer of TCPIP, ICMP, ARP, RARP, Transport layer services and principles, Connectionless v/s connection oriented services, UDP and TCP, Quality of Service, Introduction to sockets and socket programming. Application Layer:- Introduction to Cryptography, Secret key and public key algorithm, Security issues for Intranet and Internet, DNS (Domain name System), Electronic mail, World wide Web, FTP, Telnet, SNMP. **(06)**

Text Books

1. [T Vishwanathan] Telecommunication switching systems and Networks; PHI
2. [Andrew Tanenbaum] Computer networks, Prentice Hall

Reference Books

1. [William Stallings] Data and computer communications, 7th edition, Prentice Hall
2. [Kurose/Ross] Computer Networking: A Top-Down Approach Featuring the Internet, Addison-Wesley
3. [William Stallings] Computer Networks, Prentice Hall
4. [Behrouz A. Forouzan] Data Communications and Networking, 4th edition, McGraw Hill
5. [D. Comer] Computer Networks and Internet/ TCP-IP.
6. [A Nagoor Kani] Signals & Systems
7. [T L Singal] Analog & Digital Communications

TERM WORK:

The term work shall consist of record of conduct of minimum eight experiments/assignment/tutorials based on the above syllabus. Some of the experiments/assignments may be from the following list.

List of Experiments: The following experiments may be performed using software/ hardware

1. Study of Institute wide computer networking: A case study
2. To connect a printer in a network
3. Study of hardware components used in computer networking.
4. Study of OSI and TCP/IP protocols.
5. Study of simulator for experimentation with data link layer.
6. Design and development of a web page.
7. Study of Internet control protocols.
8. Write a program to implement bit-stuffing algorithm
9. Write a program to implement Bellman Ford algorithm
10. Write a program to implement character-stuffing algorithm
11. Write a program for encryption and decryption
12. Write a program for implementing Hamming code
13. Study of file transfer protocol and sliding window protocol.
14. Study and comparison of different routing algorithms.

ICE 4704: BIOMEDICAL INSTRUMENTATION

Teaching Scheme
Lectures: 4 Hrs/week
Practical: 2 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1
Bio-potential measurement ,Cell Structure, Basic Cell functions, Origins of bio-potentials, electrical activity of cells, biological Control Concept, Electrode-electrolyte interface, Half cell Potential, Polaris-able and nonpolarisable electrode, Electrode circuit model, Body surface recording electrodes for ECG, EMG and EEG, internal electrodes-needle and wire electrodes, electrodes for electric stimulation of tissue, Various biomedical transducers. (06)

Unit 2
Central Nervous systems - Receptors, sensory pathways and motor systems, processing sensory information, neural, neuromuscular, sensory muscular and sensory measurements, biofeedback, evoked response, electroencephalography (EEG), EEG amplifier. Classification of muscles – Muscle contraction mechanism, Myoelectric voltages, Electromyography (EMG). (08)

Unit 3
Cardio-vascular system - structure of heart, rhythmicity, pacemaker cell, ECG theory, ECG electrodes, Electrocardiograph, vector cardiograph. Bio-signal amplifiers and signal processing, basic requirement, Op-amp circuit, transient protection, interference reduction circuits, active filters, rate measurement, averaging and integrator circuits, Examples of physiological signals and systems including feedback systems. (08)

Unit 4
Cardiovascular Measurements and therapeutic devices Heart sound, Phonocardiography, Blood pressure measurement (invasive and noninvasive), Blood flow meter-Magnetic and ultrasound, Cardiac Output measurement, Plethysmography. Life saving devices pacemakers and defibrillators, heart lung machine. (06)

Unit 5
Special Senses- Ear: Mechanism of hearing, Sound conduction system, Basic Audiometer, Pure tone audiometer, Audiometer system Bekesey, Evoked response Audiometer system, Hearing aids. Vision- Anatomy of Eye, Visual acuity, Slit Lamp, Tonometer, Ophthalmoscope, Perimeter, LASER Applications in Ophthalmology – Diabetic Retinopathy, Glaucoma and retinal hole and detachment treatment. (06)

Unit 6
Bio-materials- Structure and property relationships in materials, ceramics and polymers, Interactions of materials with the human body, composite materials concepts and applications, Implementation problems – inflammation, rejection, corrosion, structural failure. (06)

Text Books

1. Biomedical Instrumentation by Dr. M. Arumugam, Anuradha Publishers, 1992.
2. Introduction to Biomedical Equipment Technology by Carr and Brown, Pearson LPE.
3. Medical Instrumentation Application and Design by John G. Webster, John Wiley & Sons Pvt. Ltd.
4. Biomedical Instrumentation and Measurements by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Pearson Education.
5. Principles of Biomedical Instrumentation and Measurement by Richard Aston, Maxwell Macmillan International Edition.
6. Handbook of Biomedical Instrumentation by R. S. Khandpur, TMH.
7. Medicine and Clinical Engineering by Jacobsons and Webster, PHI.

Reference Books

1. Human Physiology – The Mechanism of Body Functions by Vander, Shermen, TMH.
2. Biomedical Digital Signal Processing by Tompkins, PHI.
3. Encyclopedia of Medical Devices and Instruments by Webster Vol. I – IV.

List of Experiments: The following experiments may be performed using software/ hardware

1. Study of ECG and EEG Simulator.
2. Study of ECG amplifier.
3 study of EEG amplifier.
4. Design and implementation of Instrumentation amplifier.
5 study of Heart Rate Meter.
6. Study of Digital BP meter.
7. To study various blood Pressure Measurement techniques.
8. To calibrate the Blood Pressure apparatus.
9. To study the ultrasonic Blood Flow meter.
10. To study the ECG Recorder and determine its time constants. Also study the design aspects of ECG Recorder.
11. To design and implement the pacemaker simulator. Also study the design aspects of Pacemaker.
12. to design and implement the Defibrillator Simulator. Also study the design aspects of Defibrillator.
13. To study EMG machine
14. To study the PC Based ECG and EEG analysis System

ICE 4705: EL: 1 ADVANCED CONTROL SYSTEMS

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

Unit 1
Basic concepts of Non-linear systems:
A. Types of non-linearity, typical examples like Saturation, dead zone etc, typical examples backlash, hysteresis etc. Describing functions for different types of nonlinearity, singular points, Saddle points, Limit cycles, Vortex points, practical examples of limit cycles, Liberalization of typical system, Need for model reduction, Dominant pole concept, Model reduction via partial realization.
B. Time moment matching and pade approximation, Hankel norm model reduction (10)

Unit 2
Stability of Non-linear systems
A. Stability concepts - Equilibrium points - BIBO and asymptotic stability, Lyapunov Theory, Definitions (Stability and Functions), Direct method of Lyapunov, Application to non-linear problems Stability, analysis by describing function method -jump resonance Frequency domain stability criteria
B. Popov's method and its extensions (07)

Unit 3
Model reference adaptive systems
A. Different configurations and classifications of MRAC, Mathematical description - Direct and indirect model reference adaptive control, MIT rule for continues time MRAC systems, Lyapunov approach and hyper stability approach for continuous time MRAC systems, Lyapunov approach and hyper stability approach for discrete time MRAC systems, Multivariable systems
B. Stability and convergence studies of MRAC. **(08)**

Unit 4
Self tuning regulator
A. Different approaches to self-tuning, Recursive parameter estimation, Implicit and explicit STR, LQG self-tuning, Convergence analysis, Minimum variance and pole assignment
B. Approaches to multivariable self-tuning regulators (06)

Unit 5
Advances in self tuning regulators and its analysis
A. Recent trends in self-tuning, Robustness studies, Multivariable systems, Model updating, General-purpose adaptive regulator, Application to Process control components and systems **(06)**

Unit 6
A. Case study of Industrial Applications (03)

Text-Books:

1. "Control Systems Engineering", I. J. Nagrath and M. Gopal, 4th Ed., New Age International, 2005
2. "Adaptive Control", K. J. Astrom and Witternmark, Prentice Hall, 2002.

Reference Books:

1. "Adaptive Control", S. Astray &M. Bodson, Prentice Hall of India.
2. "Automatic control systems", B. C. Kuo, Prentice Hall of India.
3. "Stable Adaptive Control", Narendra & Anasamy, Prentice Hall of India.
4. "Control systems engineering", Norman S. Nise, John Wiley and sons, Inc, Singapore.
5. "Nonlinear systems Analysis", M. Vidyasagar, Prentice Hall of India.
6. "Nonlinear systems", Hassan K. Khalil, Prentice Hall of India.

ICE 4705: EI: 1 ROBOTICS

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

Unit 1
Fundamentals of Robotics
A. Robot definition and classification, brief history of robotics, types of robots, advantages and disadvantages of robots, robot components, Robot terminologies like position, orientation, degree of freedom, configuration, workspace (reach), kinematics,dynamics, accuracy, repeatability, path, trajectory, robot joints, robot coordinates ,robot reference frames, robot applications and social issues.
B. Robot sensors: sensor characteristics, position sensors, velocity sensors, acceleration sensors, force and pressure sensors. **(06)**

Unit 2
Robot Kinematics: Position Analysis
A.Robots as mechanisms, matrix representation, homogeneous transformation matrices,representation of transformations, inverse of transformation matrices, forward and inverse kinematics of robots, Denavit-Hartenberg representation of forward kinematic equations of robots, inverse kinematic solution of robots.
B.Inverse kinematic programming of robots. (06)

Unit 3
Differential Motions and Velocities
A.Differential relationships, Jacobian, differential motions of a frame, interpretation of the differential change, differential changes between frames, differential motions of a robot and its hand frame, calculation of the Jacobian, how to relate the Jacobian and the differential operator, inverse Jacobian.Robot sensors: range-finders, sniff sensors, vision systems, voice recognition devices,voice synthesizers, remote center compliance (RCC) device, touch and tactile sensors.
B.Robot sensors : proximity sensors, light and infrared sensors, torque sensors,microswitches.
(08)

Unit 4
Dynamic Analysis and Forces.
A. Lagrangian mechanics: a short overview, effective moments of inertia, dynamic equations for multiple-degree-of-freedom robots, static force analysis of robots,transformation of forces and moments between coordinate frames.Robot actuators: characteristics of actuating systems, comparison of actuating systems,electric motors, microprocessor control of electric motors, magneto-strictive actuators,shape-memory type metals, speed reduction techniques.
B. Hydraulic and pneumatic actuators. (08)

Unit 5
Trajectory Planning.
A. Path vs. trajectory, joint-space vs. Cartesian-space descriptions, basics of trajectory planning, joint-space trajectory planning. Cartesian-space trajectories, continuous trajectory recording.
B. Higher order trajectories. (06)

Unit 6
Robot Vision:
Machine Vision system, description, sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic assembly sensors & Intelligent Sensors. Object recognition. **(06)**

Text Books

1. "Introduction to Robotics: Analysis, Systems, Applications", Saeed B. Niku, Prentice Hall of India.
2. "Robot Technology Fundamentals", James G Keramas, Cengage Learning Publications.
3. "Robot Engineering An Integrated approach", R. D. Klafter, T. A. Chmielewski and M. Negin, Prentice Hall of India.

Reference Books

1. "Introduction to Robotics Mechanics and Control", J. J. Craig, Addison-Wesley.
2. "Industrial robotics Technology, programming and applications", M. P. Groover, McGraw-HillBook Co.

ICE 4705: EL-1 NEURAL AND FUZZY BASED CONTROL SYSTEM

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

1. **Artificial Neural Systems:** Fundamentals concepts and models of artificial neural system, neural network learning rules, Hebbian, Perceptron, delta Windrow-Hoff learning rules. (05)

2. **Single layer Perceptron Classification:** Classification model, features and decision regions, training and classification using discrete perception, algorithm and example, single layer continuous Perceptron networks for linear separable classification, multilayer feed forward networks, generalized delta learning rule, feed forward recall and error back propagation training, learning factors (08)

3. **Single layer feedback networks:** Basic concepts of dynamical systems mathematical foundation of discrete time and gradient type Hopfield networks, transient response of continuous time networks solution optimization problems (05)

4. **Neural network in control system:** Neuro control approaches, training algorithms, evaluation of training algorithms, through simulation, self running neuro-control scheme, self tuning PID neuro controller, neuro control scheme feed water bath temperature control system (07)

5. **Introduction of fuzzy control:** Introduction fuzzy control from an industrial perspective, mathematics of fuzzy control fuzzy sets, fuzzy relation, approximate reasoning representing a set of rules (08)

6. **Fuzzy knowledge based controllers FKBS design parameters:** Structure of FKBC fuzzification and defuzzification module, rule base choice of variable and contents of rules, derivation of rules, data base choice of membership function and scaling factors, choice of fuzzification, defuzzification procedure (07)

REFERENCE BOOKS:

1. M. T. Hagan, H. B. Demuth and M. Beale, "Neural Network Design" Thomson Learning, Vikas Publishing House, New Delhi, 2002.
2. J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publication House 1997.
3. S. Haykin, "Neural Networks: A Comprehensive Foundation", Pearson Education, New Delhi, 2002.
4. John Yen and Reza Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education New Delhi, 2003.
5. S. Rajsekaran, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthsis and Applications", Prentice Hall of India, 2003.
6. S. Omatu, M. Khalid and R Yusof, "Neuro Control and its Applications", Springer – Verlag, London Limited 1996.
7. D. Driankov H. Hellendoorn and M. Reinfrank, "An Introduction to Fuzzy Control", Narosa Publication House, Second Reprint, New Delhi, 1997.

ICE 4705: EL-I Open Elective

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

ICE 4706: PROJECT DESIGN -I

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term work: 50 Marks

Prerequisite:
Students have to finalize their project title based on Industrial Assignments. The projects selected should be such so as to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The term work will consist of a report prepared by the student on the project allotted to them. It may be based (i) Entirely on study and analysis of a typical Instrumentation and Control System, (ii) Experimental verification, or (iii) Design, fabrication, testing and calibration of an Instrumentation system. The students are required to submit the report based on project work done. The group of three or more student allowed to do the project if it is interdisciplinary otherwise maximum three students only.

PART II

ICE 4707: DIGITAL CONTROL SYSTEM

Teaching Scheme
Lectures: 4 Hrs/week
Practical: 2 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1
Configuration of basic digital control system, discrete transfer function, discrete model sampled data systems using z- transform, transfer function model, signal analysis and dynamic response, zero-order hold equivalent, introduction to first-order-hold equivalent, transformation between 's', 'z', 'w' plane, Stability analysis and Jury's stability criterion. (10)

Unit 2
Design using transform techniques: Root locus and frequency domain analysis compensator design. **(06)**

Unit 3
Control system analysis using state variable method, vector and matrices,. state variable representation, conversion of state variable to transfer function and vice versa, conversion of transfer function to canonical state variable models, realization using companion-I and II, Jordan canonical form, solution of state equations. (08)

Unit 4
Design using state-space methods: controllability and observability, control law design, pole placement, pole placement design using computer aided control system design (CACSD), observer design. (06)

Unit 5
Stability improvement by state feedback, digital controller for deadbeat performance. (04)

Unit 6
Introduction to advanced control strategies: Effects of dead time on system Performance and Smith's predictor algorithm, non linear and adaptive control, self tuning control, model based control, Dynamic matrix control algorithms, deadbeat, Dahalin controller etc (06)

Text Books

1. K. Ogata; Discrete Control Systems, PH, 2nd ed.
2. M. Gopal; Digital Control Engineering, TMH, 2003.

Reference Books

1. Digital Control Systems vol. I & II - Isermann, Narosa publications
2. Digital Control System- B. C. Kuo, Sounders College Publishing, 1992.
3. Designing Linear and Non linear Control Systems with MATLAB-K. Ogata, PHI, MATLAB curriculum series

List of Experiments: The following experiments may be performed using software/ hardware
All experiments are to be design with MATLAB

1. Analysis of continuous and discrete control system.
2. Study of Jury's stability criterion and analysis.
3. Digital controller design with root locus techniques.
4. Digital lead controller design with frequency domain techniques.
5. Digital lag controller design with frequency domain techniques.
6. Digital controller design with pole placement method.
7. Observer design.
8. Simulation of any digital control system based on unit 6.

ICE 4708: PROJECT ENGINEERING AND MANAGEMENT

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/week	Paper: 80 Marks
Practical: 2 Hrs/week	Term work: 25 Marks
Class test: 20 Marks	Practical: 25 Marks

Unit 1

Definition of project purpose, scope, time, quality and organization structure. Basic and detailed engineering: Degree of automation, Project S curves, manpower considerations, inter-department and inter organization interactions, Multi agency interaction. Types of projects and types of contracts e.g. EPC, BOOT etc. **(06)**

Unit 2

Role of Automation, Customer expectations and performance criterion, User Requirement Specifications (URS), Functional Design Specifications (FDS), Software Requirement Specifications and Hardware Requirement Specifications (SRS and HRS),International Standards and Practices, Consultant Requirements, Project execution steps.Instrumentation Audit, Plant layout, general arrangement drawing (plans and elevations).Setection criterion for equipment at different levels of automation. **(08)**

Unit 3

Design Engineering, documentation, Process function diagrams and interlock, interface diagrams, Process flow diagrams, P&ID, specification sheets, loop wiring diagrams,ladder diagrams, isometrics, installation detail drawing, bill of material, Control console,centers and panels: Types, design, inspection and specification. Control panel drawings, Document control, Checklists, legend sheets, instrument catalogues, test and progress reports, minutes of the meeting. Documentation software to create, modify, add, revise and update I&C documentation. Documents and version control. Cable engineering, different classes of conductors and their routines, types and specifications of cables, cable schedule, routing of cables, types of glands, ferruling and terminations, junction boxes and Junction box schedules. Field bus wiring: Terminator, power conditioners, Spurs, segments and repeater. Networking: Hubs, routes, LAN cards, and CAT cable. **(08)**

Unit 4

Procurement activities: Vendor registration, tendering and bidding process, bid evaluation, purchase orders, vendor documents, drawings and reports as necessary at above activities. Construction activities: Site conditions and planning, front availability, installation and commissioning activities and documents require/generated at this stage. Factory Acceptance Test (FAT) , On-site inspection and testing (SAT) installation sketches, bill of material, Quantity surveying, contracting, cold commissioning and hot commissioning, CAT (Customer Acceptance Test), performance trials and final handover. **(06)**

Unit 5

Management functions: Controlling, directing, project authority, responsibility,accountability, interpersonal influences and standard communication formats, project reviews. Project planning and scheduling, life cycle phases, the statement of work (SOW), projects specifications, bar charts, milestones, schedules, work breakdown structures, cost breakdown structures and planning cycle. **(06)**

Unit 6

Cost and estimation: Types and estimates, pricing process, salary and other overheads,man-hours, materials and support costs. Program evaluation and review techniques (PERT) and critical path method (CPM), estimating activity time and total program time, total PERT/CPM planning crash times, software's used in project management. (06)

Text Books

1. Applied instrumentation in process industries by Andrew and Williams, Gulf publishing.
2. Process control Instrument engineers Handbook by Liptak
3. Project management: A systems approach to planning Scheduling and Controlling by HarlodKerzner, Van Nostrand, Reinhold publishing.

Reference Books

1. Management systems ,John Bacon, ISA.
2. Batch control systems ,T.G.Fisher, ISA.
3. Instrument installation project management, ISA.

List of Experiments: The following experiments may be performed using software/ hardware

Preparation of project document of typical process:

1. Study of standards & Symbols
2. Study of Specification sheets
3. P&I diagram of typical process.
4. Wiring diagram.
5. Cable scheduling.
6. GA & Mimic diagram of control panel.
7. Control diagrams of typical process unit. (e.g. boiler, heat exchanger, distillation column etc)
8. Experiments on engineering software packages & management software's.
9. Preparation of Inquiry, Quotation, Comparative statement, Purchase orders, SAT, FAT & CAT. Inspection reports for control panel or transmitter control valve/ recorder.

ICE 4709: INSTRUMENTION SYSTEM DESIGN

Teaching Scheme
Lectures: 4 Hrs/week
Practical: 2 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks
Term work: 25 Marks
Practical: 25 Marks

Unit 1
Basic Concept of Instrumentation Design, Needs Analysis :with respect to systems deployed in; Medical, Industrial, Test and Measurement, Home Appliances, Military Functional requirements & Specifications, Impact on the design due to adverse Electrical, Thermal and Mechanical Operational Environments (08)

Unit 2
Noise Sources, Electrical, Magnetic, RF, Static, Ground Loops, Shielding, near and far field, shielding effectiveness, absorption and reflection loss, shielding with magnetic material, contact protection, glow and arc discharges, loads with high inrush current, Inductive and resistive load contact protection networks for inductive loads, intrinsic noise sources (08)

Unit 3
ESD, inductive charging human body model, ESD protection in equipment, software in ESD protection ,Sensitive devices, input filters, clamping suppressors **(04)**

Unit 4
Electronic design guideline Noise in electronic circuits. Capacitive and inductive coupling and effect of shield, shielding to prevent magnetic radiation, co-axial and twisted pair cable, grounding, safety ground, signal ground, single and multi point ground, Hybrid ground, grounding of cables shields, Ground loops and low frequency and high frequency analysis of common mode signals, guard shields **(08)**

Unit 5
Enclosure Design Guidelines. NEMA, DIN, BSI, ANSI standards Index protection (IP), cable design guidelines; Printed circuit board design guideline, layout scheme, grid systems, PCB size, Design rules for digital circuits, and Design rules for analog circuits, single and multilayer PCB, CE / Underwrites Laboratories (UL) Compliance **(06)**

Unit 6
Reliability, bath tub curve, Reliability for series parallel system, MTTF, MTTR, MTBF, availability, Redundancy and stand by systems. **(06)**

Text Books:

1. Henry OTT, "Noise reduction Techniques in Electronics Circuit", Wiley International, Second ed., 2009.

Reference Book:

1. Balguruswamy, "Reliability Engineering", TATA McGraw-hill Publication, Third ed. , 2005
2. Walter C. Bosshart, "Printed Circuit Board", Tata McGraw-Hill publication, Third ed. ,2009.
3. Considine D. M., "Process Instrumentation, and Control Handbook" McGraw Hill International
4. Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II" Chilton Book Company, 2001

5. Johnson C. D., "Process Control Instrumentation Technology" 7th Edition, Pearson Education, New Delhi, 2003.
6. Nakra Chowdhari, "Instrumentation", Prentice Hall of India, New Delhi
7. Doeblin E. O., "Measurement Systems" Fourth Edition, Application and Design, McGraw Hill International Edition, 1990.
8. Andrew Williams, "Applied Instrumentation in the Process Industries" Vol. I and Vol. II , GWF Publishing Company
9. Sawhney A. K. and Puneet Sawhney " A Course in Mechanical Measurements and Instrumentation" Dhanpat Rai and Co. (P) Ltd., New Delhi, 1998.

Term Work:

The term work shall consist of a record of at least six experiments/designs and drawings based on the syllabus given above. Some of the experiments may be from the following list.

List of Experiments:

1. Case study: One lab instrument/field instrument and its detailed engineering drawings, circuit diagrams on a drawing sheet.
2. Design of any mini project like design of instrument/electronic device/transducer/instrumentation component/system, its procedure starting from preparation of specifications, designing, testing, and erection. [Drawings dimensional sketches, circuit diagram, details of different component on drawing sheet, testing its specifications, determining practical static and dynamic characteristics]
3. Designing of a control panel along with detailed engineering drawings.
4. Designing a control valve for given specifications and detailing it with engineering drawings.
5. Designing any transmitter and drawing its details.
6. Design of any sensor/transducer for particular process variables like flow and drawing its dimensional details on a sheet.
7. Design of any sensor/transducer for particular process variables like temp and drawing its dimensional details on a sheet.
8. Design of any sensor/transducer for particular process variables like Pressure and drawing its dimensional details on a sheet.

ICE 4710: EL: 2 AUTOMOTIVE INSTRUMENTATION

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

Unit 1
Current trends in automobiles with emphasis on increasing role of electronics and software. Overview of generic automotive control ECU functioning. Overview of typical automotive subsystems and components. (06)

Unit 2
Engine Management Systems: Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors,Flow sensor, temperature, air mass flow sensors, Throttle position sensor, solenoids etc. Algorithms for engine control including open loop and closed loop control system,electronic ignition, EGR for exhaust emission control. (08)

Unit 3
Vehicle Power Train and Motion Control: Electronic Transmission Control, -Adaptive Power Steering, Adaptive cruise control Safety and comfort systems Anti-lock braking, Traction Control and Electronic Stability, Active suspension control. (06)

Unit 4
Body electronics including lighting control, remote keyless entry, immobilizers etc. Electronic instrument clusters and dashboard electronics. Aspects of hardware design for automotive including electro-magnetic interference suppression, Electromagnetic compatibility etc. (06)

Unit 5
Automotive Standards and Protocols: Automotive standards like CAN protocol, Lin Protocol, Flex Ray, OBD-II etc Automotive standards like MISRA . (06)

Unit 6
Hardware in loop testing of automotive ECU using available software/hardware platform Simulation of engine control, adaptive cruise control etc. (08)

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, 2003, Newnes (Imprint of Elsevier Science).

Reference Books

1. Young A.P. & Griffiths, " Automotive Electrical Equipment" , ELBS & New Press-1999.
2. Tom Weather Jr. &Cland c. Hunter, "Automotive computers and control system" Prentice Hall Inc., New Jersey
3. Crouse W.H., "Automobile Electrical Equipment" ,McGraw Hill Co. Inc., New York,1995.
4. Bechhold, " Understanding Automotive Electronic", SAE,1998.
5. Robert Boshe " Automotive Hand Book" (5th edition),2000.

ICE 4710: EL: 2 BUILDING AUTOMATION AND SECURITY SYSTEM

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

Unit 1
Introduction of building automation
A. Introduction of Components used in building automation system: HVAC, electrical, lighting, security, fire-fighting, communication etc. concept and application of Building Management System and Automation. Requirements and design considerations and its effect on functional efficiency of building automation.
B.Current trend and innovations in building automation system. (09)

Unit 2
HVAC system
A. Principles of HVAC system design and analysis. Different components of HVAC system like heating, cooling system, chillers, AHUs, compressors and filter units component and system selection criteria including room air distribution, fans and air circulation, humidifying and dehumidifying processes. Control systems and techniques.
B. Piping and ducting design. Air quality standards. (07)

Unit 3
Access Control & Security System
A. Concept of automation in access control system for safety. Manual security system. FID enabled access control with components like active, passive cards, controllers, and antennas, Biometric Intrusion alarm system, Components of public access (PA) System like speakers, Indicators, control panels, switches. Design aspects of PA system.
B.CCTV, IP cameras, broadband/LAN network, digital video recorder (08)

Unit 4
Fire &Alarm System
A. Different fire sensors, smoke detectors and their types. CO and CO2 sensors. Fire control panels. Design considerations for the FA system. Concept of IP enabled Fire &Alarm system. Design consideration of EPBX system and its components.
B. Integration of all the above systems to design a total building management System. (06)

Unit 5
Energy Management System
A. Trends in energy consumption, Energy audit: evaluation of energy performance of existing buildings, weather normalization methods, measurements, desegregation of total energy Consumption, use of computer models, and impact of people behavior. Energy efficiency measures in buildings: approaches, materials and equipments, operating strategies, evaluation methods of energy savings.
B.Renewable energy sources: passive or active solar systems, geothermal systems. (06)

Unit 6
Applications:
Design and develop case studies on building automation. (04)

Text Books

1. "Smart Buildings", J. Sinopoli, Fairmont Press.
2. "Web Based Enterprise Energy and Building Automation Systems', B. Capehart C.E.M, Editor.
3. "Building Automation Beyond the Simple Web Server', A. Budiardjo, Clasma Events, Inc.
4. "What is an Intelligent Building?", P. Ehrlich, Building Intelligence Group.

ICE 4710: EL-2 VLSI Design

Teaching Scheme
Lectures: 4 Hrs/week
Class test: 20 Marks

Examination Scheme
Paper: 80 Marks

Unit 1

Digital Design Fundamentals: Review of techniques of using a truth table, canonical forms to develop the AND/OR or OR/AND combinational circuit models, minimization techniques, Hazards and Hazard free circuits. Difference between combinational and sequential circuits. General model of sequential machine, timing and triggering considerations. **(08)**

Unit 2

Basic HDL Constructs: VLSI Design flow, Overview of different modeling styles in VHDL, Data types and data objects in VHDL, Dataflow Modeling, Behavioral Modeling, using VHDL for combinational Circuits and sequential Circuits. **(08)**

Unit 3

Hardware Description Language: Structural Modeling, Subprograms, Packages and Libraries, Generics, Configurations, attributes. Comparison of various Hardware Description Languages. **(06)**

Unit 4

Programmable Logic Devices: Introduction to CPLDs: Function block architecture, input/output block, switch matrix, Study of architecture of CPLDs of Altera /Xilinx . Introduction to FPGAs: Configurable logic block, input/output block and interconnect, Study of architecture of FPGAs of Xilinx /Actel /Altera. **(08)**

Unit 5

CMOS Circuits: Different logic families, MOS Transistor, CMOS as an inverter, propagation delay, power consumption/dissipation issues, simple circuits using CMOS. **(04)**

Unit 6

CMOS Processing & Digital Circuit Verification: CMOS Fabrication: Different steps of fabrication, CMOS p-well, n-Well and twin tub processes, CMOS Layout and Design rules. Simple TestBench, Simulation and Synthesis issues, case study of ALU/ Sequence Detector. **(06)**

TERM WORK:

Term work shall consist of at least eight-experiment/ programs/ assignment based on above syllabus.

TEXT BOOKS:

1. Neil H.Weste and Kamran Eshraghin, "Principles of CMOS VLSI design".
2. J Bhasker,Addison Wesley," VHDL Primer" .
3. Douglas Perry, TaTa McGRAW HILL," VHDL".
4. William I. Fletcher "An Engineering approach to Digital Design",Prentice Hall India.

REFERENCE BOOKS

1. Stephen Brown and Zvonko Vranesic,TaTa McGRAW HILL, " Fundamentals of Digital Logic with VHDL Design".
2. John Yarbrough,BROOKS/COLE, "Digital Logic Applications and Design".
3. Xilinx data Manual, " The Programmable Logic data Book".
4. J Bhasker, Addison Wesley, "A VHDL Synthesis Primer".
5. Charles Roth, McGRAW HILL, "Digital System Design using VHDL".
6. E.Sicard and Sonia Bendhia,TaTa McGRAW HILL," Basics of CMOS Cell Design ".
7. Peter Ashenden, Harcourt Asia PTE LTD," The Designer's Guide to VHDL".

ICE 4711: PROJECT WORK-II

Teaching Scheme
Practical: 2 Hrs./Week

Examination Scheme
Practical: 100 marks
Term work: 50 marks

Project to be completed with detailed design, implementation, test case preparations, testing and demonstration. The student should prepare a consolidated report in LaTeX and submit it before term end. Project stage III consist of presentation and oral examination based upon the project work report submitted by the candidates and or upon the demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of two examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or appointed by university

PRACTICAL EXAMINATION:

It shall consist of presentation and oral examination based upon the project work report submitted by the candidates and or upon the demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of minimum examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or university .

ICE 4712: CONTROL SYSTEM LAB.

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term work: 25 Marks
Practical: 25 Marks

The Students are expected to device the systems using software/hardware from the following contents and develop system hardware based on the following (At least one):

1. Observing effect of tuning parameters on system performance.
2. Design of PID controller for a SOPDT system by Ziegler Nichols method.
3. Design of feedback controller by direct controller synthesis.
4. Design a feedback controller for system with delay / RHP zero by IMC strategy.
5. Design of feed-forward controller.
6. Determine relative gain array of MIMO system.
7. Determine Morari resiliency index and Niederlinsky index of MIMO system.
8. Design of decouple.
9. Study and development of control algorithm (Fuzzy or PID) for fuel injection sstem or electronic steering.
10. Study and designing of fuel indication system
11. Study & analysis of flow, pressure, and level control loop (Analysis includes process Parameters such as type of process, dead time, capacity etc.)
12. Implementation of cascade controller.
13. Design & implementation of feed-forward controller
14. Computer simulation using Euler method.
15. Computer simulation using Runge-Kutta method.
16. Modeling and simulation of blending process.
17. Modeling and simulation of series of 3-CSTR's process.
18. Computer simulation using one dimensional optimization methods.
19. Solving problem based on linear programming (Graphical method).
20. Solving problem based on Linear programming (Simplex method).
21. Computer simulation of least square method.