FEEDBACK CONTROL SYSTEMS (304201)

Teaching Scheme: **Examination Scheme:**
Lectures/ Week: 3 Hrs **Paper: 100 Marks**

Unit I: Introduction to Feedback Control System and Mathematical Modeling
(7 Hours)

Linear & non-linear control systems, open loop & closed loop control systems with practical examples, Basic elements of FCS., Transfer Function, Block diagram reduction techniques, Signal flow graphs, Mason's gain formula.
Control system components such as AC servomotor, stepper motor, ac tacho generator, synchros, synchro error detector.
Mathematical modeling of control systems such as DC motor speed control, position control system.

Unit II: Time Domain Analysis and Stability **(6 Hours)**

Standard test signals, First order and Second order systems, Characteristic equations, Transient response of second order system, Time domain specifications, Steady state errors and error constants.
Concept of stability, Routh's stability criterion, Root locus, effect of adding poles and zeros to G(s) H(s) on Root loci.

Unit III: Frequency Domain Analysis **(7 Hours)**

Frequency domain specifications, Bode plots, Determination of Transfer Function from Bode plot, Phase margin, Gain margin, Stability analysis.
Mapping theorem, Polar plots, Stability analysis from Nyquist plots.
Compensation techniques- Lag, Lead, Lead-lag compensating networks.

Unit IV: State Space Analysis **(5 Hours)**

Concept of state variables, state model, state variable representation of control systems (SISO, MIMO), Conversion of state variable into Transfer Function and vice versa. Solution of time invariant state equations, state transition matrix, concept of controllability and observability.

Unit V: Principles of Controllers **(6 Hours)**

Overview of various transducers with their signal conditioning systems , Controller principles- ON-OFF, P, PI, PD, PID.
Programmable Logic controllers- Logic symbols, ladder diagrams, PLC operation, and programming.

Unit VI: Intelligent Control **(5 Hours)**

Fuzzy Control:
Fuzzy sets and linguistic variables, the fuzzy control scheme, Fuzzification and Defuzzification methods. Fuzzy controllers, Fuzzy control applications for process control (Temperature control, water level controller)
Introduction to neural networks:
Introduction, Humans and computers, organization of brains,biological neurals,biological and artificial neuron models,historical developments.Essentials of artificial neural networks

Text Books:

1. I. J. Nagrath, M. Gopal, "Control Systems Engineering", Third Edition, New age international Publishers.
2. Curtis D. Johnson, "Process Control Instrumentation Technology", Eighth Edition, PHI.

Reference Books:

1. Ogata, "Modern Control Engineering", Fourth Edition PHI.
2. Benjamin C. Kuo, "Automatic Control Systems", Seventh Edition, PHI.
3. Bart Kosko, " Neural Network and Fuzzy Systems", PHI

DATA COMMUNICATION (304202)

Teaching Scheme:	**Examination Scheme:**
Lectures / Week: 4 Hrs.	**Paper: 100 Marks**
Practical / Week: 2 Hrs.	**Oral: 50 Marks**

Unit I: Random Processes and Noise **(7 Hours)**

Introduction to data communication system, Impact of noise.

Random processes: Introduction and mathematical definition of random process. Statistical, analysis, Mean , Correlation, covariance, standard deviation for stationary processes, CDF and PDF for discrete and continuous random variables.

Probability Models: Binomial, Poisson's, Gaussian's and reighlay's probability distribution functions.

Various noise reduction techniques: Low Pass Filter, Matched Filters .

Unit II: Baseband Encoding **(7 Hours)**

Line coding techniques: RZ, NRZ, Unipolar, AMI, Polar, Bipolar, Manchester coding in time and Frequency domain.

Syncronizing techniques: Bit synchronization (clock recovery) techniques, Frame synchronization techniques, inter symbol interference , Eye diagram.

Multi level schemes: 2B1Q, 8B16, MLT-3 and their comparison.

Unit III: Error Detection and Correction Techniques (7 Hours)

Channel coding techniques: Linear block codes, hamming code, hamming distance, CRC, syndrome detection, convolution code, trellis diagram, free distance and coding gain, veterbi algorithm for detection.

Error control systems: FEC, ARQ Stop and Wait, go back N, selective repeat.

Unit IV: Information Theory (7 Hours)

Fundamentals of Information: Information measure, entropy, information rate, Mutual information, discrete and continuous channel capacity, Shannon theorem, Huffman coding, Shanon – Fano coding, code efficiency, Channel throughput, Binary symmetric channel.

Unit V: Digital Modulation (7 Hours)

ASK, FSK, PSK, MSK, Quadrature carrier systems, QAM, QPSK, Phase diagrams and signal constellations diagrams, coherent and incoherent detection techniques.SNR and BER Calculation for PSK, FSK, QPSK, QAM

Unit VI: Multiple Access Techniques (7 Hours)

Introduction to Multiple Access Techniques – TDMA, FDMA and CDMA in details. PN sequences, DSSS, Frequency Hopped Spread Spectrum, random access, continuous and slotted ALOHA, CSMA

Text Books:

1. Simon Haykins, “Digital Communication”,
2. Bernar Sklar, “Digital Communication”,

Reference Books

1. Taub Schilling, “Principals of Communication system”

2. Simon Haykins, “Communication Systems”

3. R.P. Singh, Sapre, “Communication Systems (Analog & Digital)”

4. Couch, “Digital and Analog Communication systems”

5. Carlson, Crilly and Rutled, “Communication Systems”

6. Forozan, “Data Communication and Networking”

7. Willan Stallings, “Data and Computer Communication”

List of Practicals:

Hardware Kits Based:

1. Study of matched filter
2. Study of various line codes and Multi level schemes/codes.
3. Study of ASK, PSK, FSK.
4. Study of QPSK.
5. Study of PN sequence.
6. Study of spread spectrum transmission (DSSS)

C Language Programs:

7. Implementation of Hamming code
8. Implementation of Convolution code and Viterbi algorithm
9. Implementation of Shannon Fano and Huffman codes

NETWORK SYNTHESIS AND FILTER DESIGN (304203)

Teaching Scheme:
Lectures / Week: 3 Hrs
Practical /Week: 2Hrs.

Examination Scheme:
Paper: 100 Marks
Term work: 50Marks

Unit I: Network Functions and Fundamentals of Network Synthesis (6 Hours)

Network functions, properties of all types of network functions, Effect of poles and zeros on the system function, network synthesis problems, elements of realizability, causality and stability, Hurwitz's polynomial, Positive real function ,elementary synthesis procedures.

Unit II: Synthesis of One Port Networks (6 Hours)

Properties of RC, RL and LC driving point functions and their synthesis in Foster and Cauer forms. Synthesis of RLC driving point functions in terms of partial fraction or continued fractions for simple driving point functions.

Unit III: Synthesis of Transfer Functions (6 Hours)

Properties of transfer function, zeros of transmission, synthesis of Y21 and Z21 with 1ohm termination. Synthesis of voltage transfer functions using constant resistance networks.

Unit IV: Passive Filter Design (6 Hours)

Butterworth and Chebyshev approximation, derivation of normalized low pass filter transfer function up to 3rd order by Butterworth approximation from basic principles. Evaluation of transfer function for Chebyshev filters from pole zero plots. Synthesis of above mentioned filters with 1ohm termination. Frequency transformation to high pass, band pass and band stop forms. Normalized low pass filters, frequency scaling and Impedance scaling.

Unit V: Active Filter Design (6 Hours)

Factored forms of the functions, cascade approach, Biquad topologies: positive and negative feedback topology, coefficient matching techniques for obtaining element values. Sallen Key low pass circuits. RC to CR transformations for high pass filter,design of, Sallen Key band pass circuit.

Unit VI: Sensitivity and Performance Parameters (6 Hours)

Definition of sensitivities,Sensitivity analysis of the above circuits with respect to parameters like Q, wo and component values. Effect of practical OP-AMP characteristics on active filter performance: Dynamic range ,slew rate, offset voltage and currents, noise.

Text Books:

1. Franklin Kuo, “Network Analysis and Synthesis” ,Wiley international.
2. Gobind Daryanani, “Principles of Active Network Synthesis and Design”, Wiley international.

Reference Books:

1. M.E. Van Valkenberg, “Analog Filter Design”, Harcourt Brace Jovanovich College Publishers.
2. Wai-Kai Chen, “Passive and Active Filters ,theory and implementations”, Wiley international
3. Lawrence Huelsman, “Active and Passive Analog Filter Design”, McGraw-Hill Inc.

List of Practicals:

(Minimum 4 practicals to be performed using software like MultiSim®)

1. Consider two port LC network, find all network functions and plot poles and zeros.
2. To carry out synthesis of one port LC network into any of the Canonical forms and verify practically.
3. To synthesize given transfer function into constant resistance network (Bridge T or Lattice) and verify practically.
4. Design a Butterworth low/high pass filter Sallen Key circuit and verify (at least 2^{nd} order).
5. Design a Chebyshev low/high pass filter Sallen Key circuit and verify (at least 2^{nd} order).
6. To find gain of biquad op amp circuit & study sensitivity of gain against the different components.
7. To study effect of op amp characteristics on filter performance and compensation techniques for the same at least one parameter to be studied practically.

MICROCONTROLLERS (304204)

Teaching Scheme
Lectures / Week: 3 Hrs
Practical /Week : 2Hrs.

Examination Scheme
Paper: 100 Marks
Practical: 50 Marks

Unit 1: Introduction to Microcontrollers (5 Hours)

Study of microprocessor architecture with suitable examples, Study of Von Newman and Harvard architecture, advantages and disadvantage, Study of microcontroller architecture and special features and its advantages, Memory interfacing with microprocessors and microcontrollers. Memory mapped and IO mapped interfacing. Clock frequency and speed of instruction execution. Measurement of performance of microprocessor.

Unit 2: Architecture of 8051 (8 Hours)

Architecture instruction set and programming with 8051 microcontroller, control word for special function registers and programming for different applications.

Unit 3: Real World Interfacing (8 Hours)

Real world interfacing with timers, counters, ADC, DAC, LED and LCD displays, keyboard and stepper motor.

Unit 4: Serial and Parallel Buses (4 Hours)

Serial and parallel bus structure. RS232, RS485, I2C, SPI, CAN interfacing using microcontroller with various devices such as EEPROM, RTC, ADC, DAC. Communication with PC using RS232.

Unit 5: Advanced Microcontrollers (6 Hours)

Study of advanced microcontroller architectures such as Microchip PIC16F, 18F, Atmel Mega32. Embedded C basic concepts, variables, data types and programming. Interfacing using PIC/AVR with real world devices such as timers, counters, ADC, DAC, LED and LCD displays, keyboard and stepper motor.

Unit 6: System Design (5 Hours)

Designing microcontroller based system such as data acquisition system. Design of sensor interfacing, selection of ADC, selection of output drivers. Writing efficient programs using

Assembly language or C.

Text Books:

1. Muhammas Mazidi, Janice Mazidi and Rolin McKinlay, 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Pearson Education, 2nd edition.
2. Kenneth J. Ayala, 'The 8051 Microcontroller', Cengage Learning.
3. Mazidi, Rolin McKinlay and Danny Causey, 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education.

Reference Books:

1. Myke Predko, 'Programming and customizing the 8051 microcontroller', TATA McGraw Hill.
2. Ajay Deshmukh, 'Microcontrollers Theory and Applications', TATA McGraw Hill.
3. Subrata Ghoshal, 'Embedded Systems and Robots- Projects using the 8051. Microcontroller', Cengage Learning.

List of Practicals

1. Programming practice with 8051
2. Interfacing with LED using timer and interrupt
3. Interfacing LCD in 4 bit and 8 bit mode
4. Interfacing matrix keyboard
5. Interfacing ADC using I2C
6. Interfacing RTC using SPI
7. PC communication using RS232
8. Embedded C program for PIC/AVR using Suitable C Cross Compiler

POWER ELECTRONICS (304205)

Teaching Scheme:
Lectures / Week: 4 Hrs
Practical /Week : 2Hrs.

Examination Scheme:
Paper: 100 Marks
Practical: 50 Marks

Unit I: 3 Phase AC/DC Converters **(7Hours)**

Analysis of 3-phase full converter, comparison with 3-phase semi converter, Effect of source impedance on single-phase converters with analysis, Single-phase and three-phase dual converters (ideal and practical dual converter, control schemes for non-circulating current type dual converter, analysis of circulating current type dual converter).

Triggering Circuit for Phase Controlled Rectifiers: Pulse forming circuits, inverse cosine method, microprocessor/microcontroller based firing circuit for 1 phase, 3 phase controlled rectifiers.

Unit II: Switched Mode DC/ DC Converters: **(7 Hours)**

Control of DC/ DC converters. Circuit diagram, Waveforms & operation (o/p voltage calculation) of step down chopper (Buck converter), Step up chopper (Boost converter) & 2-quadrant type C chopper. Circuit diagram, waveforms, operation, analysis & design aspects of Fly back converter (SMPS) including magnetics. Four Quadrant Chopper.

Unit III: Special purpose converters: **(7 Hours)**

Resonant converter: Need for resonant converters: Circuit diagram, waveforms & operation of SLR half bridge DC/DC converter in low frequency (discontinuous conduction) mode.

Cycloconverter: Single phase to single phase controlled Cycloconverter using 3 pulse and 6 pulse converter groups. Voltage and frequency control circulating, non-circulating currents mode, load and line harmonics matrix converters, and high frequency cycloconverters.

Unit IV: DC/ AC Converter **(7 Hours)**

Voltage Source Inverters:

Half Bridge and Full Bridge three phase bridge inverter square wave operation (180^o or 120^o). Frequency and voltage control .Voltage control & harmonic reduction in inverters. Three level inverters, resonant inverters. Soft switched inverters PWM converter as line side rectifier.

Current Source Inverter: 3 phase six step current source line commuted inverter, Inverter operation modes load commutated inverters with over excited synchronous machine load. Auto sequential current fed inverter PWM inverter.

Unit V: Cooling and Protection of Semiconductor Devices and Their Applications

(7 Hours)

Cooling Basic theory - thermal resistance, simple heat sink design calculations.

Types of cooling: (a) natural convection (b) forced air cooling (c) liquid cooling (d) vapour phase cooling

Protection Circuits: Snubbers, MOVs, di / dt inductor, semiconductor fuses. Design of snubber circuit.

1) Electronic ballast: characteristics of fluorescent lamps and advantages over conventional ballast

2) HVDC transmission one line diagram, twelve pulse converter, arrangement and advantages over HVAC transmission

3) HF induction heating

4) Electric welding

5) DC CT / PT

6) Protection circuits: Phase sequence monitoring, under voltage monitoring

Unit VI: Power Factor Improvement Techniques and Power Quality **(7 Hours)**

Power factor improvement: Phase angle control, semiconverter operation of full converters, asymmetric firing, forced commutation, sequence control of series converters, comparative evaluation of schemes.

Power Quality: Types of power line disturbances, Sources of power line disturbances, Preventive and nullifying measurement techniques, Measurement of power line disturbances. Energy audit.

Text Books:

1. M. H. Rashid, “Power Electronics Circuits Devices and Applications”, PHI, 3rd edition, 2004, New Delhi
2. P. C. Sen, “Thyristor DC Drives”, John Wiley & Sons.
3. N. Mohan, T. M. Undeland & W. P. Robbins, “Power Electronics, Converters Applications and Design” John Willey and sons, 3rd edition, Singapore

Reference Books:

1. U. R. Moorthi, “Power Electronics, Devices, Circuits & Industrial Applications”, Oxford University Press, New Delhi, 2005
2. M. S. Jamil Asgar, “Power Electronics”, PHI, 2004, New Delhi

3. M D Singh & K B Khanchandani, “Power Electronics”, TMH, New Delhi

List of Practicals:

Minimum 6 experiments from 1 to 8 with 9 & 10 being compulsory

1. Study of Dual Converter (1-Φ or 3-Φ).
2. Study of 3-Φ VSI (180^o or 120^o).
3. 2 Q Chopper .
4. LCC 3-Φ converter.
5. Resonant converter (Class E or ZCS or ZVS or SLR or PLR).
6. Power factor improvement techniques (SAC or EAC or PWM)
7. Study of DC CT/ PT / Electric welding / induction heating.
8. Study of cycloconverter.
9. Simulation of 3-Φ LCC (HCB or FCB or Dual Converter).
10. Simulation of 3-Φ VSI (120^o or 180^o or PWM)

ELECTRONIC DESIGN PRACTICE (304206)

Teaching Scheme
Lectures / Week: 1 Hrs.
/Week : 2Hrs.

Examination Scheme
Oral: 50 Marks Practical

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1) Design of Linear Regulated Power Supply:

Assignment of Linear Power Supplies for Laboratory use should be

Selected from any one type given below:

1) Dual Tracking.

2) Multiple Outputs CV-CC Modes.

Scope of Design:-

a) Design of Transformer.
b) Proper selection of Rectifier and its appropriate rating.
c) Filter Design and Proper selection of Filter component with rating.
d) Justified selection and Design of Regulator Circuit.
e) Current boosting using external pass/parallel transistor.
f) Over current/ Short-circuit, Over voltage, Thermal Protection.
g) Indication of V, I and mode of operation on Panel by Meter or Display.
h) Indicators for Over Voltage, Over Current.
i) Input Power considerations and Protection circuit like EMI Filters, Fuses, MCB.
j) Thermal considerations- Heat Sink calculations.
k) Enclosure Design.
l) Component List in the form of Bill of Material.
m) Performance Analysis.

2) FSM / ASM Based Digital Design.

Assignment should be based upon real life problems like Traffic Light

Control, Elevator Control, Vending Machine, Lift Control etc.

Scope of Design:-

a) Selection of State Machines: - Moore and Mealy Machines.
b) State Table and State Diagram.
c) Implementation of Combinational Logic Design in State Machine using MSI, LSI Devices like Multiplexers, Decoders, ROM's, PLD's

d) Fuse Map generation techniques, Design using PAL/PLA.
e) ASM technique includes: - Justified Algorithm and ASM Chart.
f) Representation using Simplified Block diagram.
g) Justified selection of digital circuit for each block.
h) List of digital IC's with their Logic Family Specifications and Features.

3) Data Acquisition System.

Assignment should be based on Specific Industrial Application. It should

have at least Two Channel inputs.

Scope of Design:-

a) Selection of appropriate Signal Sensing Schemes.
b) Design of signal conditioning circuits.
c) Signal conditioning may consists of V to F, F to V, Chopper Amplifier etc.
d) Selection of suitable A to D Converter.
e) Selection of Micro-controller with appropriate Interfacing circuit.
f) Output Interfacing such as V/I, Relay, RS 485, Fiber Optic Link.
g) Indication of Parameters using Analog Meter, LED/LCD Display,
a) Alphanumeric DPM **(**Use Simple scheme and one type of indication only).
h) System should include circuits such as RMS to DC Converter, PLL,
b) Log-Amplifier, Programmable Gain Amplifier, Multiplier/Divider,
c) Balanced Mixer, Error-Amplifier as and when required.
i) Component List in the form of Bill of Material.

5) Switched Mode Power Supply:

It should deliver at least two DC voltages (One voltage should be Normal

Supply voltage like 5 volts, 1 Amp and other voltage should be Dual type

Like +/- 12 volts, 1 Amp) from AC input.

Scope of Design: -

a) Justified selection of Switching regulator IC's, IGBT's or MOSFET's.
b) Decision of appropriate Topology like fly back or Forward Converter.
c) Ferrite core & L-Section filter Design.
d) Control Circuit Design.
e) Different Protection Circuits like crow bar, short circuit, thermal shutdown.
f) Consideration of Noise Suppression Technique.
g) Thermal considerations- Heat Sink calculations.
h) Enclosure Design.
i) Component List in the form of Bill of Material.
j) Performance Analysis.

1. Data and Application Manuals and Application Notes from:

1) National Semiconductor regulator design manual.
2) Analog Devices Data Manual.
3) Motorola, "Linear / Switch mode power supplies".
4) Motorola Power Transistors & Thyristors data hand book.
5) Philips Audio Data Manual.
6) BEL Transistor Manual
7) Tower's Data Manual.
8) "PIC 16XX data book."
9) Texas instruments, "Linear interface and applications circuit design"
10) RS Component Catalog
11) CEDT References.
12) "ATMEL micro controller data book."
13) Intel Peripheral Manual.

2. Reference Books:

1) Paul Horowitz, "Art of Electronics".
2) B.S.Sonde, "Power Supplies".
3) B.S.Sonde, "System Design Using Integrated circuits".
4) Hill and Peterson, "Digital System Design".
5) Franklin P. Prosser, David E. Winkel, "The Art of Digital Design", (PHI).
6) Fletcher, "Introduction to digital design".
7) Tubay Grame & Huelsmann (student Edition-Burr Brown), "Operational amplifiers"
8) Sergio Franco, "Design with Operational amplifiers and analog Integrated circuits", (3rd edition-TMH).
9) Peatman, "Micro controller system design".
10) Gotlib, "Power Supply Design".
11) Palls-Areny, "Analog Signal Processing".
12) Handbook on Sound Engineering.
13) Charles H. Roth Jr., "Fundamentals of Logic design", Fourth Edition, Jaico Book

C. Web References:

1) www. Alldatasheets.com
2) www. national.com (use free power supply design tool from National Semiconductor website and design a multi output voltage SMPS using this tool).
3) www.microchip.com
4) www.atmel.com/products
5) www.8051_hw.com
6) www.8052.com
7) www.ti.com

DRIVES AND CONTROL (304207)

Teaching Scheme: **Examination Scheme:**

Lectures / Week: 4 Hrs **Paper: 100 Marks**
Practical /Week : 2Hrs. **Practical: 50 Marks**

Unit I: DC Motor Drives **(7 Hours)**

Motor performance parameter,1ϕ &3ϕ converter drives for separately excited & series DC motors for continuous & discontinuous operations, dual converters,various protections,DC chopper drive, power factor improvement techniques(comparison between converter drive & chopper as an drive) .

Unit II: DC Drive Control **(7 Hours)**

Open loop & close loop control of dc drives with transfer function ,PLL control, microprocessor based control of dc driver, dynamic and regenerative breaking

Unit III: Induction Motor Drives & Control **(7 Hours)**

Induction motor characteristics, control strategies like stator voltage control, v/f control, rotor resistance control, use of CSI for induction motor control, PWM control, controlled slip system, slip power recovery system, close loop control, direct vector control & indirect vector control, breaking of induction motor, soft acceleration and deceleration, various protections.

Unit IV: Synchronous Motor Drives & Control (7 Hours)

cylindrical rotor motor, salient pole motor, salient pole motor & reluctance motor, close loop control of ac motor (scalar & vector control),separate control

& self control of synchronous motor.

Unit V: Special Motor Drives (7 Hours)

stepper motor drives, variable reluctance & permanent magnet stepper motor, switched reluctance motors & drives, brushless dc & ac motor drives.

Unit VI: Drives Applications (5 Hours)

Traction motor driver, PI control tuning of a drive, fussy logic based induction motor speed control, fussy logic based wind generation system, neural network based PWM controller, neuro fussy system.

Text Books:

1. M.H Rashid, "Power electronics circuit devices & application", Pearson , third edition
2. P. C. Sen, "Thyristor DC Drives", John Wiley.

Reference Book:

1. Gopal K. Dubey, "Fundamental of Electrical Drives", Narosa publishing House,
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson, Prentice Hall
3. "GE SCR MANUAL" 6th edition, General Electric, New York, USA

List of Practicals:

1. Dc motor control using semi/full single phase converter.
2. Dual converter single phase/three phase controlled dc drives.
3. Microprocessor/microcontroller based single phase/three phase controlled dc drives.
4. Four quadrant chopper reversible dc drives.
5. Three phase induction motor control using square wave/PWM invertors.
6. Microprocessor/microcontroller based single phase/three phase control AC drive.
7. Simulation of DC drives using of power SIM.
8. Simulation of AC drives using of power SIM.
9. Case study on drive application (Industrial visit).

SENSORS AND INTERFACES (304208)

Teaching Scheme :	**Examination Scheme:**
Lectures / Week: 3 Hrs.	**Paper: 100 Marks**
Practicals / Week: 2 Hrs.	**Term work: 50Marks**

Unit I: Sensors and Transducers **(6 Hours)**

Performance terminology - Displacement, Velocity and Motion sensors - Proximity sensors, Force, Pressure, Flow, Level and Temperature sensors – Humidity, pH and Conductivity sensors – Specifications and selection criteria – Inputting data by switches

Unit II: Transmitters, Signal conditioning and Converters **(6 Hours)**

Analog signal conditioning for different sensors – Use of bridge circuits and Instrumentation amplifiers – Design guidelines – Signal converters V/I, I/V, V/F, F/V, I/P & P/I converters – Evolution of two wire transmitters – Isolated two wire transmitters – Smart and Intelligent transmitters

Unit III: Digital Signal Conditioning and Interfacing **(6 Hours)**

Specifications and selection criteria for ADCs and DACs related to sensor interfacing – Input and Output interfacing – Interface requirements – Input and Output interface with Microcontrollers (89C series and PIC Microcontrollers) – Design guidelines

Unit IV: Data Acquisition, Bus Standards and Protocols **(6 Hours)**

Multichannel data logging and computer based data acquisition system – RS 232C standard, IEEE 488 bus, I^2C bus, HART protocols – Foundation Field bus and Profibus

Unit V: Actuators and Final Control elements (6 Hours)

Pneumatic and hydraulic actuators- Directional control valves, Pressure control valves, Cylinders, Process control valves - Electrical actuators- Mechanical switches, Solid state switches, Solenoids, DC motors, AC motors and Stepper motors

Unit VI: Programmable Logic Controllers, Applications and Interfacing (6 Hours)

PLC Architecture – Input / Output processing – Interfacing of Input / Output devices with PLC – Analog Input / Output - Ladder logic programming – Selection of PLC – PLC based automated systems

Text Books:

1. W. Bolton; " Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering "; Pearson Education; 3rd Edition
2. Curtis Johnson; " Process Control Instrumentation Technology "; Prentice Hall of India Pvt. Ltd.; 7th Edition
3. C.S. Rangan, G.R. Sarma, V.S.V. Mani; " Instrumentation Devices and Systems "; Tata Mc Graw Hill; 2nd Edition

Reference Books:

1. Ernest O. Doebelin; "Measurement System Application and Design "; Mc-Graw Hill; 5th Edition
2. David G. Alciatore, Michael B Histand; " Introduction to Mechatronics and Measurement System "; Tata Mc Graw Hill
3. Madhuchhanda Mitra, Samarjit Sen Gupta; " Programmable Logic Controllers and Industrial Automation, An Introduction"; Penram International Publishing India (Pvt) Ltd

List of Practicals:

1) Measurement of pH and Conductivity
2) Measurement of Vibration
3) Design and testing of Signal conditioning circuits for Thermocouple and RTD for voltage and current outputs
4) Data acquisition and analysis in LABView software
5) Calibration of Differential Pressure Transmitter (DPT) for flow and level
6) Study of Smart Transmitters
7) Sensor interface with microcontroller through Instrumentation amplifier and ADC
8) Study of pneumatic components (Direction control valves, Pressure control valves and Cylinders) and pneumatic circuits
9) Study of Electropneumatic components and their interfaces with PLC
10) Study of a PLC based Mechatronics system.

MICROCOMPUTER BASED SYSTEM (304209)

Teaching Scheme:	**Examination Scheme:**
Theory : 3 hours/week	**Theory : 100 Marks**
Practical : 2 hours/week	**Practical : 50 marks**

Unit I: Introduction to 16 bit Microprocessors **(6 Hours)**

8086 Microprocessor architecture, Pin description, Operating modes, Addressing modes, Address translation, Memory translation, Coprocessor configuration.

Unit II: Introduction to 16 bit Microprocessors: (Contd) **(6 Hours)**

8086 instruction set, interrupt structure, interrupt vector table, Memory and I/O interfacing, Assembly language programming.

Unit III: Introduction to 32 bit Microprocessors **(6 Hours)**

80386 microprocessor features and architecture, functional description, register set, real mode, protected mode and virtual 8086 mode operation, MMU, paging segmentation, cache memory, Multitasking, Interrupt structure.

Unit IV: Study of PC **(6 Hours)**

Study of mother boards, chipsets, EISA, PCI, serial port, Printer port, PS2, and USB interface, Introduction to BIOS.

Unit V: Introduction to RISC Processors (6 Hours)

ARM Processor fundamentals, registers, pipeline Exceptions, interrupts and interrupt vector table, core extensions, instruction set of ARM processor.

Unit VI: System design case studies (6 Hours)

Microprocessor based industrial process control system, Data acquisition system, DC motor control.

Text Books:

1. Walter A Triebel and Avatar Singh, " The 8086 and 8088 Microprocessors", Pearson Publications
2. Barry B Brey, " The Intel Microprocessors", Pearson Publications
3. A N Sloss, " ARM System Developer's Guide", Elsevier Publications

Reference Books:

1. Douglass V Hall, " Microprocessors and Interfacing", Tata McGraw Hill Publications
2. Furber, "ARM Chip Architecture", Pearson Publications.

List of Practicals:

1) 8086 ALP for 32 bit addition, subtraction, division and multiplication.
2) 8086 ALP using DOS or BIOS interrupts (Key borad and Display)
3) File handling handling creation, writing and reading
4) PC to PC communication using serial port (ALP)
5) ALP program for LED flashing Using ARM Processor
6) Key matrix interfacing to ARM processor,
7) LCD interfacing to ARM processor
8) ADC and DAC interfacing to ARM processor

INDUSTRIAL MANAGEMENT (304210)

Teaching Scheme **Examination Scheme**

Lectures: 3 Hrs/week **Paper: 100 Marks**

Unit I: Current Industrial Management practices**:** (6 Hours)

The basics of management theory and practices; Quality concepts, phases in quality management; Economic framework, productivity, efficiency and cost-minimization for peer group competitiveness; Globalization perspective; Examples of global business failures.

Unit II : Rise of Convergence Technology and its implication for technology industry and for incumbent industry models with risk of competitive failure from rise of upstart businesses: (6 Hours)

Convergence of computing telecommunications, consumer electronics, and content, Surveys; Elements of Convergence Technology (CT); Impact of CT on electronics, software and telecommunications industry; Impact of CT on incumbent industry models with risk of competitive failures, Examples.

Unit III: Impact of CT by way of formulation of innovative, internetworked open system view of business as potential source of information, i. e., as business *IS* view, and need to go beyond TQM and Reengineering: (6 Hours)

Mobility as value networking (creating) across the enterprise and inter-enterprise wide supply chains; Development of CT driven innovative, internetworked business models;

Example(s) of business failures in case of non-application of CT driven business models; Examples of information economy based business models; Issues in implementation, Inadequacy of TQM and reengineering techniques; Need for future development in QIS and its organizational and social implications-Complexity Advantage.

Unit IV: **Conceptual Foundations – Designing business *IS* view for complex and changing markets: (6 Hours)**

Shift from material and energy processing based exogenous business decision- making to information-origination based endogenous (dynamic) decision-making for business opportunities; Shift from task based business model to process-based business model, Shift from decision-making based on minimal (computing) information to dynamic decision-making based on maximal, shared information; Shift from Collective to Individual Design Decision leading to *IS* view of an engineering system/ an organization/ a firm/ a company/ a business; Description of maximal information for competitive advantage; Systems view of business process *IS* view and its integrity requirements; Implications of uncertainty in *IS* view - System failure from Complex Errors, Need for Information Evaluation - Introduction to Information Integrity (I*I) index, Information Integrity Risk (I*I Risk); Definitional statement of Information Integrity Technology as a new market opportunity space.

Unit V: Introduction to System Dynamics Modeling and Computer Simulation Language Tool for I*I Technology Development: (6 Hours)

System Dynamics Approach for Large, Complex Real World Problems, Problem Identification and its System Conceptualization, Introduction to the Computer Simulation Language, Model Formulation, Model Testing and Further Development, Policy Analysis and Recommendation;

Study of System Dynamics Modeling software – STELLA (its educational version).

Unit VI: Information Integrity Technology Development System: (6 Hours)

Information as a composite good of interrelated attributes namely, Usefulness (Relevance), how usable is information, and integrity (index of correctness and exactness of information); Attributes of Information integrity; I*I measurement – a definitional treatment; Graphical representation of cost-benefit analysis of I*I for obtaining optimum I*I for minimizing I*I risk in business information decision and achieve competitive advantage; Defining of information topology; Descriptive development of application of information envelope on information topology to generate flexible business information decision; Presentation of systems view of I*I Technology Development System, and its descriptive application to an illustrative problem using System Dynamics methodology.

Texts Books:

1. Dinesh Seth and Subhash C. Rastogi, “Global Management Solutions”, Cengage Learning, Second Edition, USA.
2. B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions.
3. George P. Richardson and Alexander L. Pugh III, "Introduction to System Dynamics Modeling", System Dynamics Series, PEGASUS Communications.
4. O. P. Khanna, “Industrial Engineering and Management”, Dhanpatrai Publications Ltd, New Delhi.

Web References:

1. www.ciir.org.in

Reference Books:

1. V. Rajaraman, and V. V. Mandkc, Editors, "Information Integrity: Issues and Approaches".
2. Don Tapscott, “Digital Economy”, McGraw-Hill, Inc., USA.
3. Michael Hammer, “Beyond Reengineering”, Profile Books, London.

DISCRETE TIME SIGNAL PROCESSING (304211)

Teaching Scheme
Lectures/Week: 3 Hrs

Tutorial/Week: 1Hrs

Examination Scheme
Paper: 100 Marks

Unit I: Characterization of LTIDT System: (5 Hours)

Basic elements of DSP system, advantages of DSP over analog processing, Sampling theorem, practical sampling, aliasing.Time Domain Analysis of DT System :Difference equations, Recursive solution of difference equation, zero input response, unit impulse response, system response to external input, convolution sum, total response of DT system, causal LTIDT system stability,Systems with Finite Duration and Infinite Duration Impulse response, structures for the realization of LTIDT systems, Direct form I & II

Unit II: Fourier Analysis of DT System: (7 Hours)

DTFS & DTFT, , Power & Energy density of periodic and aperiodic signals, computation of DTFT :DFT , properties of DFT, FFT, DIT, DIF

Unit III: DT System Analysis using Z- Transform: (6 Hours)

Need of Z – transform, Definition, Inverse, properties, Z-Transform solution of difference equations, Connection between DTFT and Z-Transform, System Stability and Z-Transform, classification of system using pole zero plot

Unit IV: Digital Filters: (6 Hours)

Realization of digital filter, Causality & its implications , Time domain equivalence criterion, IIR design by impulse invariance method, bilinear transformation, FIR design Linear phase conditions ,time domain equivalence method ,frequency sampling method

Unit V: Multirate Sampling: (6 Hours)

Introduction, Decimation, Interpolation, sampling rate conversion, polyphase implementation of filter.
Applications: DAC in compact Hi-Fi Systems, Acquisition of High quality data, Multirate narroband digital filtering , Hi resolution narrow band spectral analysis

Unit VI: DSP Hardware Platforms: (6 Hours)

Introduction, Difference between Microprocessor and DSPs ,General Architecture of DSPs. Case Study of TMS320C28XX , Implementation of Triggering for Converter, D.C.Motor Control ,AC Phase Control, Proportional Control.

Text Books:

1. John G.Proakis, D.G.Manolakis, “Digital Signal Processing”, Pearson Prentice Hall.
2. Emmanuel C. Ifeachor ,B.W.Jervis, “Digital Signal Processing”.

Reference Books:

1. B.P. Lathi, “Signal Processing and Linear Systems”, Oxford University Press.
2. S.K. Mitra, “Digital Signal Processing Computer Based Approach”, TMH.
3. B.Venkataramani , M. Bhaskar, “Digital Signal Processors :Architecture Programming & Applications”, TMH.
4. Avtar Singh, “Digital Signal Processors”, Cengage Learning.
5. TEXAS DSP Manual.

MINI PROJECT & SEMINAR (304212)

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs/Week **Oral: 50 Marks**

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1. **Maximum Group Size:** Minimum 2 and maximum 3 students can form a group for the mini project.

2. **Project Type:** The selected mini project must be based on development of a prototype electronic system/product mandatorily having a hardware component with supporting software.

3. **Guidelines for Mini Project** :
   - Projects enhancing the programming skills of the students and making use of softwares like Matlab, pspice, labview, cadfeko and programming languages like c, c ++ and VHDL must be promoted.
   - At an institute level, projects must preferably justify all the domains like Signal processing, Telecommunication engineering etc.
   - Theme based projects can be practiced at an institute level.
   - Software projects must be tested and analysed with all the possible inputs and must take software engineering principals into consideration.
   - Applications based on industrial automation process control and power electronics.

4. **Execution steps for Mini Projects :**

   (i) Complete Paper work Design using datasheets specifying :
   - Selection criteria of the components to be used.
   - Specifications of system i/p and desired o/p.
   - Module based hardware design.
   - Test points at various stages in various modules

   (ii) The circuit should be simulated using any of the standard simulation software available (either complete circuit to be simulated , if possible or an appropriate part of the circuit can be simulated)

   (iii) Algorithm and the flow chart of the software part must be defined.

   (iv) Result verification for hardware and testing the algorithms.

   (v) Comparison with the paper design to identify the discrepancies, if any. Justification of the same must be given.

(vi) Verified circuit should be assembled and tested on breadboard or general purpose board.

(vii) Simulation results and/or the snapshots indicating the current and voltage readings or detailing the test point results at various stages must be preserved and included in the project report.

(viii) Art work / layout of the circuit using standard layout tools.

(ix) Assembling and testing of circuit on final PCB.

(x) Design and fabrication of suitable enclosure and outside fittings such as switches, Buttons, knobs, meters, indicators, displays etc.

(xi) Final testing of the circuit using the earlier defined test points.

(xii) Preparing Bill of components and materials.

(xiii) Drawing entire circuit diagram (component level), outlining various blocks indicating test points, inputs and outputs at various stages on A3 graph sheet

5. Guidelines for the seminar :

- Seminar is based on the Mini Project topic.
- The seminar shall consist of the Literature Survey, Market survey, Basic project work and Applications of Mini project.
- Seminar Assessment shall be based on Innovative Idea, Presentation skill, depth of understanding, Applications, Future Scope and Individual Contribution.
- Maximum three students can deliver a seminar on one topic.(Three students per group)
- Each group shall be given time of 20 mins for presentation and 5 mins for question answer session.
- A certified copy of seminar/ project report shall be required to be presented to external examiner at the time of final examination.

TEST & MEASUREMENT TECHNIQUES (304213)

Teaching Scheme **Examination scheme**

Theory/Week : 01 Hr

Practical /Week : 2Hrs. **Oral: 50 Marks**

List of Experiments:

1) Study of Power scope
   a) Study difference between CRO & Power scope
   b) Analyze different power signals
2) Calibration of DVM
   c) Calibrate DVM for DC Voltage measurement.
   d) Calibration for AC Voltage measurement.
   e) Calibration for DC Current measurement.
3) Statistical Analysis
   a) Calculate mean , standard deviation, average deviation, Variance
   b) Probable error for one reading & for mean
   c) Plot histogram
   d) Compare results with 3 ½ & 6 ½ digit DMM
4) Study of DSO
   a) Different modes DSO such as Roll, Average, Peak Detection
   b) Capture transients
   c) FFT analysis
   d) Various MATH operations
5) Study of True RMS meter
   Measure RMS , Peak , Average , Vtrms of various waveforms

   For example output of Haff controlled circuit or Full controlled circuit
6) Study of programmable LCR meter
   a) Measure L , C & R
   b) Measure Q & Dissipation factor of given component

7) Study of Spectrum Analyzer
   a) Harmonic analysis
   b) Test frequency response of filters & HF amplifier
   c) Spectrum of AM & FM
8) Study of Logic Analyzer
   Timing & state analysis of given DUT

9) Study of Frequency Counter
   Principle of frequency counter, study of its different modes of measurement & different techniques for High frequency measurement

   Measurement of various parameters such as frequency, time, ratio, pulse width

10) Virtul Instrument Modelling using software like Labview.
11) Study of Emulator
   To debug the target hardware on real time basis.