DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. FINAL YEAR

Electronics & Instrumentation Engineering, Instrumentation & Control Engineering, Applied Electronics & Instrumentation, Instrumentation Engineering

ON

CHOICE BASED CREDIT SYSTEM (CBCS)

[Effective from the Session: 2019-20]

EVALUATION SCHEME

B.Tech Electronics & Instrumentation Engineering, B.Tech Instrumentation & Control Engineering, B.Tech Applied Electronics & Instrumentation, B.Tech Instrumentation Engineering

YEAR 4th, SEMESTER VII

Sr. No.	Sub Code	Subject Name	Dept.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					ESE	CT	TA		
1		Open Elective-I	Other Dept.	3--0--0	70	20	10	100	3
2		Departmental Elective-III	Core Deptt.	3--0--0	70	20	10	100	3
3		Departmental Elective-IV	Core Deptt.	3--1--0	70	20	10	100	4
4	RIC701	Control System II	Core Deptt.	3--1--0	70	20	10	100	4
5	RIC702	Telemetry Principles	Core Deptt.	3--0--0	70	20	10	100	3
6	RIC751	Control System Lab - II	Core Deptt.	0--0--2	50	-	50	100	1
7	RIC752	Telemetry Lab	Core Deptt.	0--0—2	50	-	50	100	1
8	RIC753	Industrial Training Viva-Voce	Core Deptt.	0--0—3	-	-	100	100	2
9	RIC754	Mini Project	Core Deptt.	0--0--6	-	-	200	200	3
	TOTAL				450	100	450	1000	24

LIST OF DEPT. ELECTIVES:

Elective – III Departmental Elective III

1. RIC070 Optical Instrumentation
2. RIC071 Power Plant Instrumentation
3. RIC072 Voice Over IP
4. REC073 Advance Programming in Engineering

Elective – IV Departmental Elective IV

1. REC078 Computerized Process Control
2. REC076 Filter Design
3. REC077 Applied Fuzzy Electronic Systems
4. REC075 Optical Communication

EVALUATION SCHEME

B.Tech Electronics & Instrumentation Engineering, B.Tech Instrumentation & Control Engineering, B.Tech Applied Electronics & Instrumentation, B.Tech Instrumentation Engineering

YEAR 4TH , SEMESTER VIII

Sr. No	Sub Code	Subject Name	Dept.	L-T-P	Th/LAB Marks	Sessional		Subject Total	Credit
					ESE	CT	TA		
1		Open Elective-II	Other Dept.	3-0-0	70	20	10	100	3
2		Departmental Elective-V	Core Deptt.	3-1-0	70	20	10	100	4
3		Departmental Elective-VI	Core Deptt.	3-0-0	70	20	10	100	3
4	RIC851	GD & Seminar	Core Deptt.	0-0-3			100	100	2
5	RIC852	Project	Core Deptt.	0-0-12	350	-	250	600	12
	TOTAL				560	60	380	1000	24

LIST OF DEPT. ELECTIVES:

Elective –V Departmental Elective V

1. RIC080 Biomedical Signal Processing (NPTEL : https://nptel.ac.in/courses/108105101/3)
2. REC081 Analytical Instrumentation
3. REC080 Electronic Switching
4. REC082 Advance Display Technologies & Systems

Elective – VI Departmental Elective VI

1. RIC085 Biomedical Instrumentation
2. RIC086 Optimal Control Systems (NPTEL https://nptel.ac.in/courses/108105019/ & https://nptel.ac.in/courses/108107098/)
3. REC088 Micro and Smart Systems (NPTEL: https://nptel.ac.in/courses/112108092/)
4. REC087 Speech Processing

CONTROL SYSTEM II

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand the concept of sampling & signal conversion and basics of Z-Transform.
2. Analyse transfer function of system and PID controller.
3. Design state space analysis of sampled data systems.
4. Design digital controls using state space analysis.
5. Mechanize control algorithms using microprocessors.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the concept of sampling & signal Conversion and basics of Z-Transform, and frequency–domain characteristic.
CO2	Calculate Transfer Functions, Block Diagrams, and Signal flow Graphs, Pulse Transfer Function and the Z-Transfer Function.
CO3	Realize Pulse Transfer function, State Equations for sampled Data Systems, Concepts of Controllability and Observability.
CO4	Formulate the optimal control Problem Optimal State Regulator and optimal state estimation.
CO5	Formulate Digital quantization, Microprocessor based Position Control System.

CONTROL SYSTEM II		**3 1 0**
Unit	**Topic**	**Lectures**
I	**Sampling and Signal Conversion:** Sampled-Data Control Systems, Digital to Analog Conversion, Sample and Hold operations, Sample and Hold Devices, frequency–Domain Characteristic of Zero order Hold. **The Z-Transform:** Linear Difference equations, The Pulse Response, The Definition of the Z transform, Relationship between the Laplace transform and the Z transform, Relationship between S -plane and the Z-plane, The constant Damping Loci, The constant Frequency Loci, The constant-Damping Ratio Loci, The Inverse Z-Transform, Theorems of the Z-transform, Limitations of the Z-transform, Application of the Z-transform ,Stability Analysis, Systems with Dead-Time.	10
II	Transfer Functions, Block Diagrams, and Signal flow Graphs The Pulse Transfer Function and The Z-Transfer Function, The Pulse Transfer Function of the Zero-Order Hold and the Relation Between G(s) and G(z), Closed loop systems, The Sampled Signal flow Graph, The Modified Z-transfer function, Multirate Discrete Data System. Transform Design of Digital Controls Design of position Servo Design Specifications, Design on the W- plane, Design of the W-plane, the Digital PID Controllers.	10

III	State Space Analysis of Sampled Data Systems Discrete time state equations. Similarity Transformations, The Cayley-Hamilton Theorem, Realization of Pulse Transfer function, State Equations for sampled Data Systems, Concepts of Controllability and Observability, Liapunov Stability Analysis Systems with Dead time.	**7**
IV	Design of digital controls using State Space analysis Formulation of the optimal control Problem Optimal State Regulator, Use of State Regulator results, Eigen value Assignment by State feedback, State observers Stochastic optimal State Estimation.	**6**
V	Mechanization of Control algorithms Using Micro Processors General Description of Microcontrollers, Digital quantization, Microprocessor based Position Control System.	**7**

Text Books:

1. M. Gopal, "Digital Control Engineering", New Age International Publishers.
2. B.C. Kuo,"Digital Control Systems", Oxford University Press.

Reference Books:

1. Venkatesh & Rao, "Control Systems", Cengage

TELEMETRY PRINCIPLES

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Basic System, Classification, Non electrical telemetry systems, Voltage and current Telemetry systems.
2. Analyze Frequency Division Multiplex System- FDM, IRIG Standards, FM circuits, Phase Modulation Circuits.
3. Design Modems.
4. Design Transmitter and Receiver.
5. Analyse Filters.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the concept of Basic System, Classification, Non electrical telemetry systems, Voltage and current Telemetry systems, Frequency Telemetering, Power line carrier communication.
CO2	Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system.
CO3	Realize Modems & modem protocol.
CO4	Formulate Transmission Techniques, Inter stage Coupling, Receiver Antennas: The Ideal structure, dipoles.
CO5	Design Active RC Filters, Universal Filter Circuits, Switched Capacitor Filters, Digital Filters Basics of Satellite and Fiber Optic.

TELEMETRY PRINCIPLES		**3 0 0**
Unit	**Topic**	**Lectures**
I	Introduction to Telemetry Principles: Basic System, Classification, Non electrical telemetry systems, Voltage and current Telemetry systems, Frequency Telemetering, Power line carrier Communication.	**4**
II	Multiplexed System: Frequency Division Multiplex System- FDM, IRIG Standards, FM circuits, Phase Modulation Circuits, Receiving end, Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system, PAM/ PM systems, TDM-PCM System, Digital Multiplexer, PCM Reception, Coding for varying level, DPCM, Standards.	**10**
III	Modems: Modems Introduction, QAM, modem protocol.	**4**
IV	Transmitter and Receiver: Transmitters, Transmission Techniques, Inter stage Coupling, Receiver Antennas: The Ideal structure, dipoles, arrays, current distribution and design consideration, Microwave Antennas.	**10**
V	Filters: Polynomial, Filters, Active RC Filters, Universal Filter Circuits, Switched Capacitor Filters, Digital Filters Basics of Satellite and Fiber Optic Telemetry Data Acquisition Systems (DAS), µP based DAS, Remote Control	**12**

Text Books:

1. D Patranabis, Telemetry Principle; TMH Ed 1 1999.

CONTROL SYSTEM LAB II

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Discrete Time LTI model.
2. Evaluate digital DC motor speed control with PID controller.
3. Design Lead & Lag Compensators and Kalman Filter design.
4. Write a Matlab Program to find
    a. LTI characteristics
    b. PID control response
5. Write a program to check for controllability and observability for the second order system.

COURSE OUTCOME : After completion of the course student will be able to:

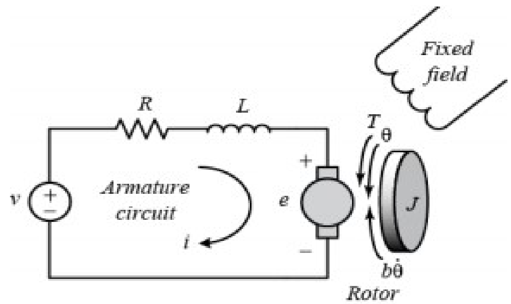
CO1	Understand the Discrete Time LTI model.
CO2	Design Discrete pole locations & transients response.
CO3	Evaluate Digital DC motor Speed control with PID controller.
CO4	Design Lead & Lag Compensators, and Kalman Filter design.
CO5	Perform State space design for the Inverted pendulum and Consider modelling of DC Motor.

CONTROL SYSTEM LAB II

1. Discrete Time LTI model.
2. Discrete pole locations & transients response

    Small damping ($\varepsilon = 0.1$ $W_n = 4\pi/5T$) Medium damping ($\varepsilon = 0.4$ $W_n = 11\pi/5T$)

    Large damping ($\varepsilon = 0.8$ $W_n = \pi/4T$)
3. Digital DC motor Speed control with PID controller.
4. Designing Lead & Lag Compensators.
5. Kalman Filter design.
6. State space design for the Inverted pendulum.
7. Consider modelling of DC Motor shown in figure.



The motor Physical Parameters are

(J)	Moment of inertia of the rotor	0.01 $kg.m^2$
(b)	Motor viscous friction constant	0.1 N.m.s
(Ke)	Electromotive force constant	0.01 V/rad/sec
(Kt)	Motor torque constant	0.01 N.m/Amp
(R)	Electric resistance	1 Ohm
(L)	Electric inductance	0.5 H

and the design requirements are

i. Settling time less than 2 seconds
ii. Overshoot less than 5%
iii. Steady-state error less than 1%

Write a Matlab Program to find

a) LTI characteristics
b) PID control response

8. Write a program to check for controllability and observability for the second order system.
9. Write a MATLAB program to compute and display the poles and zeros, to compute and display the factored form, and to generate the pole-zero plot of a z-transform that is a ratio of two polynomials in z^{-1} . Using this program, Find and plot the poles and zeroes of G(z) .Also Find the radius of the resulting poles.
10. To design feedback and feedforward compensators to regulate the temperature of a chemical reactor through a heat exchanger.

TELEMETRY LAB

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Measure Temperature Using RTD/ Thermister and amplification to an appropriate level suitable for Tele transmission.
2. Realize PCM signal using ADC and reconstruction using DAC using 4-bit/8 bit systems.
3. Understand Manchester coding & decoding (Biphase L) of NRZ-L Data AND Coding and decoding NRZ-L into URL-L (Unipolar return to Zero coding.)
4. Analyze ASK FSK PSK– Modulation and Detection.
5. Analyze Error, Detect Error & Correct it using Hamming Code.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand Measurement of Temperature Using RTD/ Thermister and amplification to an appropriate level suitable for Tele transmission
CO2	Realize PCM signal using ADC and reconstruction using DAC using 4-bit/8 bit systems
CO3	Analyse Manchester coding & decoding (Biphase L) of NRZ-L Data AND Coding and decoding NRZ-L into URL-L (Unipolar return to Zero coding
CO4	Learn ASK FSK PSK– Modulation and Detection
CO5	Analyze Error introduction, Error Detection & Correction using Hamming Code

TELEMETRY LAB

Minimum of 10 experiments to be performed.

1. Measurement of Temperature Using RTD/ Thermister and amplification to an appropriate level suitable for Tele transmission.
2. Sampling through a S/H Circuit and reconstruction of the sampled signal. Observe the effect of sampling rate & the width of the sampling pulses.
3. Realization of PCM signal using ADC and reconstruction using DAC using 4-bit/8 bit systems. Observe the Quantization noise in each case.
4. Fabricate and test a PRBS Generator.
5. Realization of data in different formats such as NRZ-L, NRZ-M and NRZ-S.
6. Clock recovery circuit from NRZ-L data using PLL.
7. Manchester coding & decoding (Biphase L) of NRZ-L Data.

8. Coding and decoding NRZ-L into URL-L (Unipolar return to Zero coding).
9. ASK – Modulation and Detection.
10. FSK – Modulation and Detection.
11. PSK - Modulation and Detection.
12. Error introduction, Error Detection & Correction using Hamming Code.
13. Amplitude modulation and Detection of signal obtained from experiment no.1

DEPARTMENT ELECTIVES - III

OPTICAL INSTRUMENTATION

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Light Sources, Transmitting and Receiving .
2. Analyse Opto –Electronic devices and Optical Components
3. Design Interferometry
4. Learn Holography.
5. Analyse Fiber optic fundamentals and Measurements.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the Concept of Light, Classification of different phenomenon based on theories of light, Basic light sources and its Characterization, Polarization Computer.
CO2	Design Photo diode, PIN, Photo-Conductors, Solar cells, ,Phototransistors, Materials used to fabricate LEDs and Lasers
CO3	Realize Interference effect, Radio-metry, types of interference phenomenon and its Application, Michelson's Interferometer and its application
CO4	Aware of Principle of Holography, On-axis and Off axis Holography, Application of Holography, Optical data storage. Optical Fiber Sensors
CO5	Understand Fundamental of Fibers, Fiber Optic Communication system, Optical Time domain Reflectometer (OTDR)

OPTICAL INSTRUMENTATION 3 0 0		
Unit	**Topic**	**Lectures**
I	Light Sourcing, Transmitting and Receiving Concept of Light, Classification of different phenomenon based on theories of light, Basic light sources and its Characterization, Polarization , Coherent and Incoherent sources, Grating theory, Application of diffraction grating, Electro - optic effect, Acousto-optic effect and Magneto-optic effect	**8**
II	Opto –Electronic devices and Optical Components Photo diode, PIN, Photo-Conductors, Solar cells, ,Phototransistors, Materials used to fabricate LEDs and Lasers Design of LED for Optical communication, Response times of LEDs ,LED drive circuitry, Lasers Classification :Ruby lasers, Neodymium Lasers, He- Ne Lasers, CO2 Lasers, Dye Lasers, Semiconductors Lasers, Lasers Application	**8**

III	Interferometry Interference effect, Radio-metry, types of interference phenomenon and its Application, Michelson's Interferometer and its application Fabry-perot interferometer, Refractometer, Rayleigh's interferometers, Spectrographs and Monochromators, Spectrophotometers, Calorimeters, Medical Optical Instrument	**8**
IV	Holography: Principle of Holography, On-axis and Off axis Holography, Application of Holography, Optical data storage. Optical Fiber Sensors: Active and passive optical fiber sensor, Intensity modulated, displacement type sensors, Multimode active optical fiber sensor (Micro bend sensor)Single Mode fiber sensor -Phase Modulates and polarization sensors	**8**
V	Fiber optic fundamentals and Measurements: Fundamental of Fibers, Fiber Optic Communication system, Optical Time domain Reflectometer (OTDR), Time domain dispersion measurement, Frequency Domain dispersion measurement, Laser Doppler velocity meter.	**8**

Text Books:

1. J. Wilson & J. F. B. Hawkes, "Optoelectronics: An Introduction" PHI/ Pearson
2. Rajpal S. Sirohi "Wave Optics and its Application", Hyderabad, Orient longman Ltd.
3. A. Yariv, "Optical Electronics", C. B. S. Collage Publishing, New York, 1985.

Reference Books:

1. G. Hebbar, "Optical Fiber Communication", Cengage

POWER PLANT INSTRUMENTATION

COURSE OBJECTIVE:

1. To create awareness of energy resources and its scenario in India.
2. To study the concept of power generation using various resources.
3. To study the role of Instrumentation in power plants.
4. To study and compare various power plants for optimal performance.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the renewable and Non-renewable energy resources
CO2	Known Method of power generation, layout and energy conversion process, Types of Turbines & control.
CO3	Understand Hydroelectric Power Plant- Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants
CO4	Be aware of Wind Energy and Solar Energy
CO5	Understand Nuclear power generation, control station and reactor control. Comparison of various plants

POWER PLANT INSTRUMENTATION 3 0 0		
Unit	**Topic**	**Lectures**
I	Energy sources, their availability, worldwide energy production, energy scenario of India. Introduction to Power generation- Classification: Renewable and non-renewable energy generation resources. Renewable: small hydro; modern biomass; wind power; solar; geothermal and bio-fuels. Non-renewable: fossil fuels (coal, oil and natural gas) and nuclear power. Boiler: Types of boilers, boiler safety standards. Boiler instrumentation, control and optimization, combustion control, air to fuel ratio control, three element drum level control, steam temperature and pressure control, boiler interlocks, sequence event recorder, data acquisition systems	**8**
II	Thermal Power Plant- Method of power generation, layout and energy conversion process, Types of Turbines & control, Types of Generators, condensers. Types of pumps and Fans, variable speed pumps and Fans, Material handling system, study of all loops-water, steam, fuel etc.	**8**

III	Hydroelectric Power Plant- Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants, Types of Turbines for hydroelectric power plant, pumped storage plants, storage reservoir plants	**8**
IV	Wind Energy: Power in wind, Conversion of wind power, Aerodynamics of wind turbine, types of wind turbine, and modes of operation, power control of wind turbines, Betz limit, Pitch & Yaw control, wind mill, wind pumps, wind farms, different generator protections, data recording, trend analysis, troubleshooting & safety. Solar Energy: solar resource, solar energy conversion systems: Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety	**8**
V	Nuclear Power Plant: Nuclear power generation, control station and reactor control. Comparison of various plants: Comparison of thermal power plant, hydroelectric power plant, wind, solar, nuclear power plant on the basis of: Performance, efficiency, site selection, Economics-capital and running, safety standards, pollution, effluent management and handling. Power plant safety, Pollution monitoring, control Sound, Air, smoke, dust, study of Electrostatic precipitator	**8**

Text Books:

1. G.F. Gilman, “Boiler Control Systems Engineering”, ISA Publication.
2. P. K. Nag, “Power Plant Engineering”, McGraw Hill.

Reference Books:

1. B. H. Khan, “Non-conventional Energy Resources”, McGraw Hill.
2. Chetan Singh Solanki, “Renewable Energy Technology”, Prentice Hall Publication.
3. S. P. Sukhatme, “Solar Energy”, Tata McGraw Hill.
4. G. D. Rai, “Nonconventional Energy Sources”, Khanna Publication.

VOICE OVER IP

COURSE OBJECTIVE: Students undergoing this course are expected to :

1. Understand the basic principle of VoIP.
2. Understand the different signaling protocols.
3. Learn about how to improve the quality of service (VoIP).

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the characteristics of the Call signaling systems.
CO2	Design SIP Architecture.
CO3	Model and estimate media gateways.
CO4	Understand the network synchronization and management.
CO5	Evaluate the quality of service the need for QoS.

VOICE OVER IP		**3 0 0**
Unit	**Topic**	**Lectures**
I	**Introduction:** Carrier-Grade, VoIP, VoIP Challenges, Overview of the IP Protocol Suite, The Internet Protocol, IP Version 6, IP Multicast, The Transmission Control Protocol, The User Datagram Protocol, The Stream Control Transmission Protocol, The Real-Time Transport Protocol, The RTP Control Protocol, Security and Performance Optimization. **Speech-Coding Techniques** A Little about Speech, Audio, and Music, Voice Sampling, Voice Quality, Types of Speech Coders, Waveform Coders, Analysis-by-Synthesis Codecs, G.722–Wideband Audio	**8**
II	**Signalling Protocols:** H.323: Multimedia Conferencing over IP The H.323 Architecture, RAS Signalling, Call Signalling, Call Scenarios, H.245 Control Signalling, Conference Calls, Securing an H.323 Network. **The Session Initiation Protocol** The SIP Architecture, Overview of SIP Messaging Syntax, Examples of SIP Message Sequences, Redirect and Proxy Servers, The Session Description Protocol, Usage of SDP with SIP, SIP Extensions and Enhancements, Usage of SIP for Features and Services, Interworking.	**8**
III	**Distributed Gateways and the Softswitch Architecture** Separation of Media and Call Control, Softswitch Architecture, Protocol Requirements for Controlling Media Gateways, Protocols for Controlling Media Gateways, MGCP, MEGACOP/H.248.1.	**8**

IV	**VoIP and SS7** The SS7 Protocol Suite, SS7 Network Architecture, ISUP, Performance Requirements for SS7, SIGTRAN, Interworking SS7 and VoIP Architectures	**8**
V	**Quality of Service** The Need for QoS, Overview of QoS Solutions, The Resource Reservation Protocol, DiffServ, Multiprotocol Label Switching, Combining QoS Solutions.	**8**

Text Books:

1. Richard Swale, Daniel Collins,“ Carrier-Grade VoIP”, McGraw-Hill Education 3rd Edition,2014.
2. Olivier Hersent, Jean Pierre Petit, David Gurle, “IP Telephony – Deploying Voice Over IP Protocols”, John Wiley & Sons Ltd, 2005

ADVANCE PROGRAMMING IN ENGINEERING

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand interactive computation techniques and learn algorithm development in Matlab.
2. To apply Matlab programming skills in communication engineering applications.
3. To apply Matlab programming skills in control system applications.
4. To apply Matlab application in neural networks and fuzzy logic.
5. To apply Matlab programming skills in digital signal processing applications.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the fundamentals of Matlab programming as well as understand and apply advance level programming techniques for solving problems using numerical methods.
CO2	Learn, apply, and investigate Matlab applications in advance communication systems.
CO3	Apply and investigate stability of systems and processes using time domain and frequency domain stability criterions like Routh-Hurwitz, State-space representation, Bode plots and Root Locus techniques.
CO4	Learn, apply, and investigate Matlab applications in neural networks and fuzzy logic.
CO5	Learn, apply, and investigate Matlab applications in digital signal processing including multi-rate DSP algorithms.

ADVANCE PROGRAMMING IN ENGINEERING 3 0 0		
Unit	**Topics**	**Lectures**
I	Introduction of MATLAB, MATLAB fundamental, Interactive Computation: Logical vectors, logical operations, logical functions, Matrix and Arrays, matrices, matrix operations, MATLAB Graphics: Basics 2-D plots, 3-D plots, handle graphics, Saving and printing graphs, Linear equations. Loops, Error and Pitfalls. Program design and algorithm development, MATLAB scripts and functions and data import-export utilities.	8
II	MATLAB Applications in Communication Systems: Introduction, Generation and detection of AM, FM, and PM signals, Sampling of signals, Pulse modulation techniques (PAM, PWM, PPM), PCM, Digital modulation techniques (ASK, PSK, FSK, M-ary), OFDM, Spread-spectrum techniques	8
III	MATLAB Applications in control system: Introduction, Laplace and Inverse Laplace Transform, Transfer function, Zero, Poles and Pole – Zero map of a transfer function, State-Space representation, series/cascade, parallel and feedback Connections, Time response of control systems Routh Hurwitz Criteria. Root Locus, Frequency response Representation: Bode plots, Gain	8

	Margin, Phase Margin, Polar Plot, Nyquist Plot.	
IV	MATLAB Application in Neural Networks: Introduction, salient features of artificial neural networks, ANN Architectures, Application using multilayer perceptron, ANN based control. MATLAB Application in Fuzzy Logic Systems: Introduction, Linguistic variables and membership functions, fuzzy operations, rule matrix, fuzzy inference systems, washing machine problem, fuzzy controller example (Water Bath).	8
V	MATLAB Application in Digital Signal Processing: Introduction, signal and systems classification, operations on discrete-time signals, Multirate signal processing functions, convolution, Z- Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Digital Filtrer Design.	8

Text Books:

1. Raj Kumar Bansal, Ashok Kumar Goel and Manoj Kumar Sharma, "MATLAB and its Applications in Engineering ", Pearson 14th impression,2014.
2. Brian H. Hahn and Daniel T. Valentine, "Essential MATLAB for Engineering and Scientists", Academic Press, Elsevier, 5th edition, 2013.
3. Rudra Pratap, "MATLAB- A quick introduction for Scientists and Engineers", Oxford University Press, 2013.
4. www.mathworks.com

DEPARTMENT ELECTIVES - IV

COMPUTERISED PROCESS CONTROL

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Basics of Computer-Aided Process Control.
2. Analyse Industrial communication System.
3. Design Process Modelling for computerized Process control.
4. Design Advanced Strategies For Computerised Process control.
5. Analyse Computerized Process Control.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.
CO2	Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system
CO3	Realize Process model, Physical model, Control Model. Modelling Procedure.
CO4	Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.
CO5	Design Electric Oven Temperature Control, Reheat Furnace Temperature control.

COMPUTERISED PROCESS CONTROL 3 1 0		
Unit	**Topic**	**Lectures**
I	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer –Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	**8**
II	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System	**8**
III	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	**8**
IV	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	**8**

V	Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.	**8**

Text Books:

1. S. K. Singh, "Computer Aided Process control", PHI.

Reference Books:

1. C. L. Smith, "Digital computer Process Control", Ident Educational Publishers.
2. C. D. Johnson, "Process Control Instrumentation Technology", PHI.
3. Krishan Kant, "Computer Based Industrial Control"
4. Pradeep B. Deshpande & Raymond H. Ash, " Element of Computer Process Control with Advance Control Applications", Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, "Digital Control System Theory", Tata McGraw Hill.

FILTER DESIGN

COURSE OBJECTIVE: Students undergoing this course are expected to :

1. Understand about the characteristics of different filters.
2. Understand the concept of Approximation Theory.
3. Learn about the switched capacitor filter.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Choose an appropriate transform for the given signal.
CO2	Choose appropriate decimation and interpolation factors for high performance filters.
CO3	Model and design an AR system.
CO4	Implement filter algorithms on a given DSP processor platform.

FILTER DESIGN 3 1 0		
Unit	**Topic**	**Lectures**
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First order filter: Bilinear transfer functions and frequency response – Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.	8
III	Second order low pass and band pass filters: Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8
IV	Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited. Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design Inverse chebyshev and cauer filters: Inverse chebyshev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design	8

Text Books:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, "Analog Filter Design", 2^{nd} Indian Edition, Oxford University Press.

Reference Books:

1. J. Michael Jacob ,"Applications and Design with Analog Integrated Circuits", Second edition, PHI learning.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, "Continuous-Time Active Filter Design", CRC Press.

APPLIED FUZZY ELECTRONIC SYSTEMS

COURSE OBJECTIVE : Students undergoing this course are expected to:

1. Understand Fuzzy Sets, Possibility Distributions.
2. Analyse Fuzzy Rule.
3. Be aware of uncertainty in information.
4. To learn Approximate method of Extension.
5. Analysis Fuzzy Logic in Control Engineering.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory.
CO2	Design Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models.
CO3	Realize Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties.
CO4	Be aware of Principle of Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic.
CO5	Understand Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture.

APPLIED FUZZY ELECTRONIC SYSTEMS	**3 1 0**	
Unit	**Topic**	**Lectures**
I	History of Fuzzy Logic, Fuzzy Sets, Possibility Distributions, Fuzzy Rules, Fuzzy Sets, Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory, Fuzzy Relations and their Compositions, Fuzzy Graphs, Fuzzy Numbers, Functions with Fuzzy Arguments, Arithmetic Operations of Fuzzy Numbers.	**8**
II	Fuzzy Rules: Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models: Mamdani Model, TSK Model, Standard Additive Model, Fuzzy Implications and Approximate Reasoning: Propositional Logic, First Order Predicate Calculus, Fuzzy Implications Approximate Reasoning, Criteria and Family of Fuzzy Implications, Possibility vs. Probability, Probability of Fuzzy Event, Probabilistic Interpretations of Fuzzy Sets, Fuzzy Measure.	**8**

III	Uncertainty in information; Classical Sets, Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties, The a- Level Set, Cardinality of Fuzzy Relations and their properties; Composition; Tolerance and Equivalence relationship; Membership Functions; Fuzzification and Defuzzification process; Fuzzy to Crisp Conversions; Lambda cuts; Extension Principle, Crisp functions and its mapping, Fuzzy functions and its mapping; Fuzzy Numbers; Internal Analysis in Arithmetic.	**8**
IV	Approximate method of Extension, Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic; Approximate Reasoning; Fuzzy Tautologies, Contradictions, Equivalence, and Logical Proof; Fuzzy Rule Based Systems, Models of Fuzzy AND, OR, and Inverter; Fuzzy Algebra; Truth Tables; Fuzzy Functions; Concept of Fuzzy Logic Circuits; Fuzzy Flip- Flop; Fuzzy Logic Circuits in Current Mode, Furry Numbers.	**8**
V	Fuzzy Logic in Control Engineering: Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture. Fuzzy Logic in Hierarchical Control Architecture, Historical Overview and Reflections on Mamdani`s Approach, Analysis of Fuzzy Control System via Lyapunov`s Direct Method, Linguistic Approach to the analysis of Fuzzy Control System, Parameter Plane Theory of Stability, Takagi-Sugeno-Kang Model Of Stability Analysis.	**8**

Text Books:

1. John Yen, Reza Langari, "Fuzzy Logic: Intellegent Control and Information", Pearson Publication.
2. Ahmad M. Ibrahim, "Introduction to Applied Fuzzy Electronics", Prentice Hall Publication.
3. Ahmad M. Ibrahim, "Fuzzy Logic for Embedded Systems Applications", Newnes Publications.
4. Witold Pedrycz, Fernando Gomide, "Fuzzy Systems Engineering: Toward HumanCentric Computing", John Wiley Publications.

OPTICAL COMMUNICATION

COURSE OBJECTIVE:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion, SM fibers.
3. To learn the various optical sources, materials and fiber splicing.
4. To learn the fiber optical receivers and noise performance in photo detector.
5. To learn link budget, WDM, solitons and SONET/SDH network.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Familiarize with basic concepts and theory of Optical Communication
CO2	Demonstrate OPCOMM components, assemble them and solve problems on Optical Communication system
CO3	Able to design, implements, analyse and maintains optical communication system
CO4	Gain knowledge of different source of light as well as receiver and their comparative study
CO5	To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

OPTICAL COMMUNICATION		**3 1 0**
Unit	**Topic**	**Lectures**
I	Overview of optical fiber communication: The general system, Advantages of optical fiber communication. Optical spectral band. Optical Fiber waveguides: Introduction, Ray theory transmission Total internal reflection, acceptance angle, numerical aperture, skew rays. Electromagnetic mode theory for optical propagation: Electromagnetic waves, modes in a planar guide, phase and group velocity, phase shift with total internal reflection and the evanescent field, goos hanchen shift.	10
II	Cylindrical Fiber: modes, mode coupling, step index fibers Graded index fibers, Single mode Fiber: Cut-off wavelength, Mode field diameter and spot size, effective refractive index, Group delay and mode delay factor, The Gaussian approximation, equivalent step index methods. Signal distortion in optical fibers - Attenuation, Material Absorption, losses in silica glass fibers; Intrinsic absorption, Extrinsic absorption. Linear scattering losses; Ray light scattering, Mie scattering. Non linear Scattering losses: fiber bending losses; Dispersion, Chromatic dispersion: material dispersion, waveguide dispersion. Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber. Overall fiber dispersion Multimode fiber, Dispersion modified single mode fibers ,Dispersion–shifted fiber, dispersion flatted fibers, nonzero-dispersion-shifted fibers (MZ-DSF), Polarization: Fiber birefringence, polarization mode dispersion, polarization-maintaining fibers, Non-linear effects: Scattering effects, Kerr effects.	10
	Optical sources - Light Emitting Diodes (LEDs): Structures, light source materials,	

III	Quantum Efficiency on LED Power Modulation of a LED, Laser Diodes- models and threshold conditions, laser diode rate equations, External quantum efficiency, resonant frequency, laser diode structures and radiation patterns, single mode lasers modulation of laser diodes, laser lines.	6
IV	Source to fiber power launching, Source Output patterns, Power coupling calculation, Power launching versus wavelength, equilibrium numerical aperture. Photo detectors: Physical principles of photodiodes: The PIN photo detector, Avalanche photodiodes. Photo detector Noise: Noise sources, signal to noise ration. Detector Response time: Depletion layer photocurrent, response time structure of in GaAs APDs, Temperature effect on Avalanche gain, comparison of photo detectors	6
V	Optical receiver operation: Fundamental receiver operation: Digital signal transmission, error sources, front end amplifier. Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit. Eye Diagram: Eye Pattern Features, BER and Q Factor Measurement Coherent Detection: Fundamental concepts, Homodyne detection, heterodyne detection, IBER comparisons. Digital links: Point to point links, power penalties.	8

Text Book:

1. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill , 5th Edition, 2013.
2. John M. Senior, “Optical Fiber Communications”, PEARSON, 3rd Edition, 2010.

Reference Books:

1. Sanjay Kumar Raghuwanshi, Santosh Kumar, “Fiber Optical Communications”, University Press, 2018.
2. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3rd Edition, 2004.
3. Oseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4th Ed, 2004.

DEPARTMENT ELECTIVES -V

BIOMEDICAL SIGNAL PROCESSING

COURSE OBJECTIVE:

1. To understand the basic Physiology of - Nervous system, Circulatory system, Respiratory system and Urinary system.
2. To understand the concept of action potential, electrode theory and different biopotential characteristics and recording methods.
3. To study various computer aided devices for biomedical applications.
4. To study and understand basics of biotelemetry systems.
5. To study the use of physiological assist devices

COURSE OUTCOME: After completion of the course student will be able to

CO1	Understand the origin of bio-potentials and their physical significance.
CO2	Understand anatomy and functioning of human heart and its common problems.
CO3	Analyze ECG, ENG and EMG signals and instrumentation.
CO4	Compare different techniques of measuring blood pressure, blood flow and volume.
CO5	Interpret the principle and operation of therapeutic and prosthetic devices.
CO6	Differentiate between the various techniques for measurement of parameters.

BIOMEDICAL SIGNAL PROCESSING 3 1 0		
Unit	**Topic**	**Lectures**
I	Introduction to Bio-Medical Signals: Classification, Acquisition and Difficulties during Acquisition. Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retinography Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.	10
II	ECG: Measurement of Amplitude and Time Intervals, QRS Detection (Different Methods), ST Segment Analysis, Removal of Baseline Wander And Power line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors.	8
III	Data Reduction: Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding.	8
IV	EEG: Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition. Study of pattern of brain waves, Epilepsy-Transition, detection and Estimation. EEG Analysis By Spectral Estimation: The Bt Method, Periodogram, Maximum Entropy Method & AR Method, Moving Average Method. The ARMA Methods, Maximum Likelihood Method	7
V	EP Estimation: by Signal Averaging, Adaptive Filtering:- General Structures of Adaptive filters, LMS Adaptive Filter, Adaptive Noise Cancelling, Wavelet Detection:- Introduction, Detection By Structural features, Matched Filtering, Adaptive Wavelet Detection, Detection of Overlapping Wavelets.	7

Text Books:

1. Willis J. Tomkin, “Biomedical Digital Signal Processing”, PHI.
2. D. C. Reddy, “Biomedical Signal Processing”, McGraw Hill
3. Crommwell Weibel and Pfeifer, “Biomedical Instrumentation and Measurement”, PHI

Reference Books:

1. Arnon Cohen, “Biomedical Signal Processing (volume-I)”, Licrc Press\
2. Rangaraj M. Rangayyan, “Biomedical Signal Analysis A Case Study Approach”, John Wiley and Sons Inc.
3. John G. Webster, “Medical instrumentation Application and Design”, John Wiley & Sons Inc

ANALYTICAL INSTRUMENTATION

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand UV – Visible Spectroscopy.
2. Understand Infrared Spectroscopy.
3. Learn working of flame photometers.
4. Interpret working of mass Spectrometers.
5. Be aware of Nuclear Magnetic Resonance (NMR) Spectroscopy.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the Electromagnetic Radiation, Laws relating to absorption radiation, Absorption Instruments, Ultraviolet and visible absorption spectroscopy, Calorimeters.
CO2	Design basic components of IR Spectrophotometers, Type of Infrared Spectrophotometers, Sample Handling Techniques.
CO3	Learn principle, constructional details of flame photometers, types of flame photometers, types of flame photometers.
CO4	Be aware of Basic Mass Spectrometer, Principle of operation, Type of Mass Spectrometers, components of Mass Spectrometers, inductively coupled plasma-mass spectrometer.
CO5	Understand the Principle of NMR, types of NMR spectrometers, constructional details of NMR spectrometer

ANALYTICAL INSTRUMENTATION 3 1 0		
Unit	**Topics**	**Lectures**
I	UV – Visible Spectroscopy: Introduction, Electromagnetic Radiation, Laws relating to absorption radiation, Absorption Instruments, Ultraviolet and visible absorption spectroscopy, Calorimeters, Double Beam spectrophotometer (Optical Diagram & Block Diagram) Microprocessor based Spectrophotometer (Block Diagram)	8
II	Infrared Spectroscopy, Basic Components of IR Spectrophotometers, Type of Infrared Spectrophotometers, Sample Handling Techniques	8
III	Flame photometers: principle, constructional details of flame photometers, types of flame photometers, types of flame photometers, clinical flame photometers, accessories for flame photometer, expression for concentration, interferences in flame photometry, procedure for determinations. Atomic Absorption Spectrometers: Atomic Absorption Spectroscopy, Atomic Absorption Instrumentation, Sources of interferences, meter scale.	8
IV	Mass Spectrometers: Basic Mass Spectrometer, Principle of operation, Type of Mass Spectrometers, components of Mass Spectrometers, inductively coupled plasma-mass spectrometer, trapped ion analyzers, ion cyclotron resonance (ICR)	8

	mass spectrometer, quadruple ion trap mass spectrometer, applications of mass spectrometry, gas chromatograph-mass spectrometer, liquid chromatograph-mass spectrometer, tandem mass spectrometry (MS/MS)	
V	Nuclear Magnetic Resonance (NMR) Spectroscopy, Principle of NMR, types of NMR spectrometers, constructional details of NMR spectrometer, variation T-60A NMR spectrometer, sensitivity enhancement for analytical NMR-spectroscopy, Fourier transform NMR spectroscopy.	8

Text Books:

1. DA Skoog, “Principles of Instrumental Analysis,” 6^{th} Ed. Cengage
2. R. S. Kandpur, “Handbook Of Analytical Instruments”, Mc Graw Hill 3^{rd} Edition,
3. Willard, Merritt, Dean and Settle, “Instrumental Methods of Analysis”, 7^{th} Edition, CBS Publishers.

ELECTRONIC SWITCHING

COURSE OBJECTIVE: Student will be able to:

1. Attain knowledge about analog and digital electronic switching.
2. Estimate traffic congestion in any telecom network.
3. Learn about call processing functions and various signalling schemes.
4. Gain the knowledge of packet switching, ATM and Banyan network switch.

COURSE OUTCOMES:

CO1	Describe and apply fundamentals of telecommunication systems and associated technologies.
CO2	Solve problems and design simple systems related to tele-traffic and trunking efficiency.
CO3	Understand and explain the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.
CO4	Understand the principles of the internal design and operation of telecommunication switches, and the essence of the key signalling systems that are used in telecommunication networks.

ELECTRONIC SWITCHING	**3 1 0**	
Units	**Topic**	**Lectures**
I	Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register-transistor-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.	8
II	Digital Switching: Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems , Digital Switching in an Analog Environment	8
III	Telecom Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems	8
IV	Control of switching systems: Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control. Signalling: Introduction, Customer line signalling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signalling, Inter-register signalling, Common-channel signalling principles, CCITT signalling system no. 6 and 7, Digital customer line signalling.	8

V	Packet Switching: Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space-Memory switch, Banyan Network Switch).	8

Text Books:

1. Thiagarajan Viswanathan & Manav Bhatnagar, "Telecommunication Switching Systems andNetworks", PHI.
2. J.E. Flood, "Telecommunication Switching, Traffic and Networks", Pearson Education.
3. John C. Bellamy, "Digital Telephony", John Wiley, 3rd Ed.

ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS

COURSE OBJECTIVE : Students undergoing this course are expected to:

1. Understand properties of light.
2. Analysis Display Glasses, Inorganic Semiconductor TFT Technology.
3. Be aware of Inorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays.
4. Evaluate performance of Paper-like and Low Power Displays.
5. Analyse Micro-display technologies.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception.
CO2	Learn the process of Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays.
CO3	Compare Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays
CO4	Be aware of colorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Autostereoscopic 3-D Technology
CO5	Understand Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology.

ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS		**3 1 0**
Unit	**Topics**	**Lectures**
I	Properties of Light, Geometric Optics, Optical Modulation; Vision and Perception: Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception; Driving Displays: Direct Drive, Multiplex and Passive Matrix, Active Matrix Driving, Panel Interfaces, Graphic Controllers, Signal Processing Mechanism; Power Supply: Fundamentals, Power Supply Sequencing.	8
II	Display Glasses, Inorganic Semiconductor TFT Technology, Organic TFT Technology; Transparent Conductors, Patterning Processes: Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays: Attributes, Technologies Compatible with Flexible Substrate and Applications, TFT Signal Processing Techniques; Touch Screen Technologies: Introduction, Coatings, Adhesive, Interfaces with Computer Mechanism.	8
III	Inorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays, Filed Emission Displays; Plasma Display Panels, LED Display Panels; Inorganic Electroluminescent Displays: Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays:	8

	OLEDs, Active Matrix for OLED Displays; Liquid Crystal Displays: Fundamentals and Materials, Properties of Liquid Crystals, Optics and Modeling of Liquid Crystals; LCD Device Technology: Twisted Numeric and Super twisted Numeric Displays, Smectic LCD Modes, In-Plane Switching Technology, Vertical Aligned Nematic LCD Technology, Bi-stable LCDs, Cholesteric Reflective Displays; LCD Addressing, LCD Backlight and Films, LCD Production, Flexoelectro-Optic LCDs.	
IV	Paper like and Low Power Displays: Colorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Autostereoscopic 3-D Technology, Volumetric and 3-D Volumetric Display Technology, Holographic 3-D Technology; Mobile Displays: Trans-reflective Displays for Mobile Devices, Liquid Crystal Optics for Mobile Displays, Energy Aspects of Mobile Display Technology.	8
V	Micro-display Technologies: Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology; Micro-display Applications: Projection Systems, Head Worn Displays; Electronic View Finders, Multi-focus Displays, Occlusion Displays, Cognitive Engineering and Information Displays; Display Metrology, Standard Measurement Procedures, Advanced Measurement Procedures: Spatial Effects, Temporal Effects, Viewing Angle, Ambient Light; Display Technology Dependent Issues, Standards and Patterns, Green Technologies in Display Engineering.	8

Text Book:

1. Janglin Chen, Wayne Cranton, Mark Fihn , “Handbook of Visual Display Technology”, Springer Publication.

DEPARTMENT ELECTIVES -VI

BIOMEDICAL INSTRUMENTATION

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand General Mathematical Procedures
2. Analysis cardiovascular measurements.
3. Learn respiratory system measurements
4. Learn working of ophthalmology instruments.
5. Analysis Bio-telemetry.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the Man-Instrumentation system Components, Problems encountered in measuring a living system.
CO2	Design Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement.
CO3	Realization of Physiology of Respiratory system. Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipments.
CO4	Aware Electroretinogram, Electro -oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic techniques.
CO5	Understand The components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise.

BIOMEDICAL INSTRUMENTATION		**3 0 0**
Unit	**Topic**	**Lectures**
I	Introduction: Specifications of bio-medical instrumentation system, Man-Instrumentation system Components, Problems encountered in measuring a living system. Basics of Anatomy and Physiology of the body. Bioelectric potentials: Resting and action potentials, propagation of action potential, The Physiological potentials – ECG, EEG, EMG, ERG, EOG and Evoked responses. Electrodes and Transducers: Electrode theory, Biopotential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes, Biomedical Transducer.	8
II	Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement, Heart sound measurement. Pacemakers and Defibrillators. Patient Care & Monitoring: Elements of intensive care monitoring, displays, diagnosis, Calibration & Reparability of patient monitoring equipment.	8

III	Respiratory system Measurements: Physiology of Respiratory system. Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipments: Inhalators, Ventilators & Respirators, Humidifiers, and Nebulizers & Aspirators. Nervous System Measurements: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.	8
IV	Ophthalmology Instruments: Electroretinogram, Electro -oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic techniques: Ultrasonic diagnosis, Eco - cardiography, Eco-encephalography, Ophthalmic scans, X-ray & Radio-isotope diagnosis and therapy, CAT-Scan, Emission computerized tomography, MRI	8
V	Bio-telemetry: The components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring. Prosthetic Devices and Therapies: Hearing Aides, Myoelectric Arm, Dia-thermy, Laser applications in medicine.	8

Text Books:

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", 3rd Ed., Mc Graw Hill Education.
2. Chatterjee & Miller, "Biomedical Instrumentation Systems," Cengage.
3. S. K. Venkata Ram, "Bio-Medical Electronics &Instrumentation (Revised)", Galgotia.
4. J. G. Webster (editor), "Medical Instrumentation Application & Design", 3rd Ed WILEY, India

Reference Book:

1. Cromwell, "Biomedical Instrumentation and Measurements" PHI
2. J. G. Webster, "Bio- Instrumentation", Wiley
3. S. Ananthi, "A Text Book of Medical Instruments", New Age International
4. Carr & Brown, "Introduction to Biomedical Equipment Technology", Pearson
5. Pandey & Kumar, "Biomedical Electronics and Instrumentation", Kataria

OPTIMAL CONTROL SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand General Mathematical Procedures
2. Analyse Optimal Feedback Control.
3. Be aware of Stochastic Optimal Linear Estimation and Control Stochastic processes
4. Learn Microprocessor and DSP control Basic computer Architecture.
5. Analyse Effect of finite World Length and Quantization on Controllability.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the Formulation of the optimal control Problem, Calculus of variations, Minimum principle.
CO2	Design Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results of solve other linear problems.
CO3	Realize linear systems, Optimal Estimation for Linear Discrete time Systems Stochastic Optimal Linear Regulator,
CO4	Be aware of Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors.
CO5	Understand Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.

OPTIMAL CONTROL SYSTEMS		**3 0 0**
Unit	**Topic**	**Lectures**
I	General Mathematical Procedures: Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Dynamic Programming, Numerical Solution of Two-point Boundary value problem.	**8**
II	Optimal Feedback Control: Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results of solve other linear problems, Suboptimal Linear regulators, Minimum-time Control of Linear Time-Invariant System.	**8**
III	Stochastic Optimal Linear Estimation and Control Stochastic processes and linear systems, Optimal Estimation for Linear Discrete time Systems Stochastic Optimal Linear Regulator,	**8**

IV	Microprocessor and DSP control Basic computer Architecture, Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors,	**8**
V	Effect of finite World Length and Quantization on Controllability and Closed Loop –Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.	

Text Books:

1. M. Gopal, "Modern Control Engineering", New Age International Publishers.
2. B.C. Kuo, "Automatic Control Systems", 10^{th} Ed. McGraw Hill.

Reference Book:

1. Brain D.O. Anderson, John B. Moore, "Optimal control Linear Quadratic Methods", Prentice Hall of India Private Limited

MICRO AND SMART SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Microsystems versus MEMS
2. Analyse micro sensors, actuators, systems and smart materials.
3. Evaluate Micromachining technologies.
4. To learn Modeling of solids in Microsystems.
5. Analysis Integration of micro and smart systems.
6.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the Why miniaturization?, Microsystems versus MEMS, Why micro fabrication.
CO2	Design Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor.
CO3	Realize silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining.
CO4	Understand bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams
CO5	Understand integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems

MICRO AND SMART SYSTEMS		**3 0 0**
Unit	**Topics**	**Lectures**
I	Introduction, Why miniaturization?, Microsystems versus MEMS, Why micro fabrication?, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems,.	8
II	Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor, an electrostatic combo -drive, a magnetic micro-relay, portable blood analyzer, piezoelectric inkjet print head, micro-mirror array for video projection, smart materials and systems.	8
III	Micromachining technologies: silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.	8
IV	Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of	8

	beams and shear stresses, dealing with large displacements, In-plane stresses. Modelling of coupled electromechanical systems: electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electro-mechanics.	
V	Integration of micro and smart systems: integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.	8

Text book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, "Micro and smart systems", Wiley India, 2010.

SPEECH PROCESSING

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand digital models for speech signals.
2. To analyse time domain methods of speech sampling.
3. To evaluate short time Fourier analysis.
4. To learn homomorphic speech processing.
5. To understand Linear Predictive Coding of Speech.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models.
CO2	Understand time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate.
CO3	Design of filter banks, implementation of filter bank summation method using FFT.
CO4	Evaluate homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing.
CO5	Understand basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations.

SPEECH PROCESSING		**3 0 0**
Unit	**Topics**	**Lectures**
I	Digital models for speech signals: Mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models, and digital models for speech signals.	6
II	Time Domain methods of speech sampling: Time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, discrimination between speech& silence, pitch period estimation using parallel processing, short time autocorrelation function & AMDF, pitch period estimation using autocorrelation function	10
III	Short time Fourier Analysis: Definition and properties, design of filter banks, implementation of filter bank summation method using FFT, spectrographic displays, pitch detection, analysis by synthesis phase, vocoder and channel vocoder.	8
IV	Homomorphic speech processing: Homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing, formant estimation, Homomorphic vocoder	6

V	Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations for auto correlation method, prediction error and normalized mean square error, frequency domain interpretation of mean squared prediction error relation of linear predictive analysis to lossless tube models, relation between various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.	10

Text Book:

1. R. L. Rabiner & R.W. Schafer, “Digital Processing of speech signals”, Pearson Education.
2. B. Gold and Nelson Morgon, “Speech and audio signal processing”, Wiley India Edition,2006.