Ch. Charan Singh University Campus Meerut

EVALUATION SCHEME & SYLLABUS

FOR

B. ECH. FOURTH YEAR

ELECTRONICS AND INSTRUMENTATION ENGINEERING

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2021-22]

B.Tech. VII Semester

Electronics and Instrumentation Engineering

S. No.	Course Title	Periods			Evaluation Scheme				End Semest		Total	Credits
		L	T	P	CT	TA	Total	PS	TE	PE		
1.	HSMC -1 #/HSMC-2 #	3	0	0	30	20	50		100		150	3
2.	Department Elective –IV	3	0	0	30	20	50		100		150	3
3.	Department Elective –V	3	0	0	30	20	50		100		150	3
4.	Open Elective-II	3	0	0	30	20	50		100		150	3
5.	Lab for Department Elective	0	0	2				25		25	50	1
6.	Mini Project or Internship Assessment**	0	0	2				50			50	1
7.	Project I	0	0	8				150			150	4
	MOOCs (Essential for Hons. Degree)											
	Total										**850**	**18**

Elective Lab
Telemetry Principles
Control Lab II

B.Tech. VIII Semester

Electronics and Instrumentation Engineering

S. No.	Course Title	Periods			Evaluation Scheme				End Semeste		Total	Credits
		L	T	P	CT	TA	Total	PS	TE	PE		
1.	HSMC -1 #/HSMC-2 #	3	0	0	30	20	50		100		150	3
2.	Open Elective –III	3	0	0	30	20	50		100		150	3
3.	Open Elective –IV	3	0	0	30	20	50		100		150	3
4.	Project II	0	0	18				100		300	400	9
	MOOCs (Essential for Hons.											
	Total										**850**	**18**

B.Tech 4rd Year
VII Semester
Syllabus

	Telemetry Principles	3L:0T:0P	3 Credits

Unit	Topics	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, TDMPCM System, Digital Multiplexer, PCM Reception, Coding for varying level, DPCM, Standards.	10
III	**Modem:** 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 Book:

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

Course Outcomes: At the end of this course students will demonstrate the ability to:

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

	Biomedical Instrumentation	3L:0T:0P	3 Credits

Unit	Topics	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 Book:

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", 3rd Ed., Mc Graw Hill Education.
2. Cromwell, "Biomedical Instrumentation and Measurements" PHI
3. Chatterjee & Miller, "Biomedical Instrumentation Systems," Cengage.
4. S. K. Venkata Ram, "Bio-Medical Electronics &Instrumentation (Revised)", Galgotia.

Reference Books:

1. J. G. Webster (editor), "Medical Instrumentation Application & Design", 3rd Ed WILEY, India
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

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe the Man-Instrumentation system Components, Problems encountered in measuring living system.
2. Design Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement.
3. Realization of Physiology of Respiratory system. Measurement of breathing mechanism Spirometer. Respiratory Therapy equipments.
4. Recognize the basics of Electroretinogram, Electro -oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic techniques.
5. Classify the components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise.

	Applied Fuzzy Electronic Systems	3L:0T:0P	3 Credits

Unit	Topics	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 Human Centric Computing", John Wiley Publications.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Explain the Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory.
2. 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.
3. Realize Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties.
4. Interpret the Principle of Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic.
5. Describe the fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture.

	Power Plant Instrumentation	3L:0T:0P	3 Credits

Unit	Topics	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 biofuels. 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.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Recognize the renewable and Non-renewable energy resources
2. Explain the method of power generation, layout and energy conversion process, Types of Turbines & control.
3. Classify Hydroelectric Power Plant- Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants.
4. Interpret the knowledge of Wind Energy and Solar Energy.
5. Explain Nuclear power generation, control station and reactor control. Comparison of various plants

	VLSI Design	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**Introduction:** VLSI Design flow, general design methodologies; critical path and worst case timing analysis, overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging, CMOS Logic, Propagation Delay definitions, sheet resistance.	8
II	**Interconnect Parameters:** Resistance, Inductance, and Capacitance, skin effect and its influence , lumped RC Model, the distributed RC Model, transient Response, RC delay model, Linear Delay Model, Logical Effort of Paths, Scaling.	8
III	**Dynamic CMOS design:** steady-state behavior of dynamic gate circuits, noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, problems in single-phase clocking, two-phase non-overlapping clocking scheme, Sequential CMOS Logic Circuits, Layout design.	8
IV	**Semiconductor Memories:** Dynamic Random Access Memories (DRAM), Static RAM, non-volatile memories, flash memories, Pipeline Architecture. Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling,	8
V	**Introduction to Testing:** Faults in digital circuits. Modeling of faults, Functional Modeling at the Logic Level, Functional Modeling at the Register, Structural Model and Level of Modeling. Design for Testability, Ad Hoc Design for Testability Techniques, Controllability and Observability, Introduction to Built-in-self-test (BIST) Concept.	8

Text Book:

1. Sung-Mo Kang & Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis & Design”,Mcgraw Hill, 4th Edition.
2. Neil H.E.Weste, David Money Harris, “CMOS VLSI Design – A circuits and Systems Perspective” Pearson, 4th Edition.
3. D. A. Pucknell and K. Eshraghian, “Basic VLSI Design: Systems and Circuits”, PHI, 3rd Ed., 1994.

Reference Books:

1. R. J. Baker, H. W. Li, and D. E. Boyce, "CMOS circuit design, layout, and simulation", Wiley-IEEE Press, 2007.
2. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Express the concept of VLSI design and CMOS circuits and delay study.
2. Analyze mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits.
3. Design and analyze various combinational & sequential circuits based on CMOS technology.
4. Examine power logic circuits and different semiconductor memories used in present day technology.
5. Interpret faults in digital circuits, Fault Models and various Testing Methodologies.

	Optical Instrumentation	**3L:0T:0P**	**3 Credits**

Unit	Topics	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 :Rubylasers, 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

Course Outcomes: At the end of this course students will demonstrate the ability to:

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

	Control System-II	3L:0T:0P	3 Credits

Unit	Topics	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:

Reference Books:

1. Venkatesh & Rao, “Control Systems”, Cengage

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Explain 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. Analyse the control algorithms using microprocessors.

	Computerized Process Control	3L:0T:0P	3 Credits

COURSE OBJECTIVE: Students undergoing this course are expected to:

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

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 Processcontrol 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.

	Wireless and Mobile Communication	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**Wireless Communication Fundamentals:** Evolution of mobile radio communication fundamentals. General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modeling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modeling.	8
II	**Spread Spectrum and Diversity:** Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.	8
III	**Equalization and Multiple Access:** Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC- FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.	8
IV	**Cellular Networks:** GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.	8
V	**Other Wireless Networks:** Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G & 5G and concept of NGN.	8

Text Books:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications, first edition.
3. T L Singal, "Wireless Communications", McGraw Hill Publications, 2010.

Reference Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Express the basic knowledge of mobile radio & cellular communication fundamentals and their application to propagation mechanisms, path loss models and multi-path phenomenon.
2. Analyze the performance of various voice coding and diversity techniques.
3. Apply the knowledge of wireless transmission basics to understand the concepts of equalization and multiple access techniques.
4. Examine the performance of cellular systems being employed such as GSM, CDMA and LTE using various theoretical and mathematical aspects.
5. Express basic knowledge of Mobile Adhoc networks and the existing & upcoming data communication networks in wireless and mobile communication domain.

	Micro and Smart Systems	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**Miniaturization:** Introduction, Need of miniaturization, Microsystems versus MEMS, Need of 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 beams and shear stresses, dealing with large displacements, In-plane stresses. **Modeling of coupled electromechanical systems:** Electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electro-mechanics.	8
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 Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Aatre, "Micro and smart systems", Wiley India, 2010.
2. S Nihtianov, A. Luque "Smart Sensors and MEMS", Woodhead publishing limited 2014.

E - Resources: https://nptel.ac.in/courses/112/108/112108092/

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Interpret the need of Microsystems and Miniaturization.
2. Design the smart materials, actuators and Micro sensors.
3. Interpret the Micromachining Technologies.
4. Analyze the modeling of solids in Microsystems.
5. Evaluate the case studies of mart systems.

Telemetry Lab	0L:0T:2P	1 Credit

SUGGESTIVE LIST OF EXPERIMENTS:

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

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe Measurement of 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. Analyse Manchester coding & decoding (Biphase L) of NRZ-L Data AND Coding and decoding NRZ-L into URL-L (Unipolar return to Zero coding)
4. Interpret the basic principle of ASK FSK PSK– Modulation and Detection.
5. Analyze Error introduction, Error Detection & Correction using Hamming Code

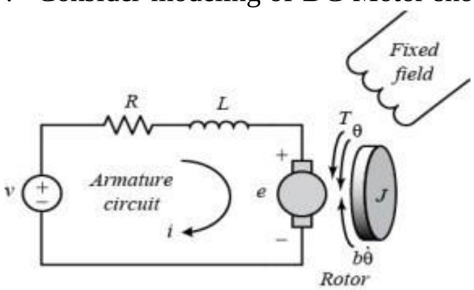
Control Lab II	0L:0T:2P	1 Credit

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 ordersystem.

SUGGESTIVE LIST OF EXPERIMENTS:

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 modeling 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 ordersystem.
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 zeroesof G(z) .Also Find the radius of the resulting poles.
10. To design feedback and feed-forward compensators to regulate the temperature of a chemical reactor through a heat exchanger.