COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Electrical and Communication Engineering

Curriculum Structure & Detailed Syllabus

S.Y. B. Tech.
Instrumentation and Control Engineering

(Effective from: A.Y. 2024-25)

S. Y. B. Tech. Instrumentation & Control Engineering

Semester -III

Sr. No.	Course Type	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
								Theory			Laboratory	
								MSE	TA	ESE	ISE	ESE
01	PCC	Sensors and Transducers	3	0	2	1	4	30	20	50	50	50
02	PCC	Analog Electronics	3	0	2	1	4	30	20	50	50	50
03	OE	Electrical Machines and Drives	2	0	0	1	2	30	20	50	--	--
04	ES-07	Numerical Methods	0	1	2	0	2					
05	HSMC	Indian language	2	0	0	0	2	CIE: 100			--	--
06	VEC	Environmental Studies	1	0	0	2	1	CIE: 100			--	--
07	CEA	Community Engagement Activity (CEA)/Field Project	-	-	-	-	2	--	--	--	CIE: 100	
08	HSMC	Entrepreneurship	2	0	0	1	2	30	20	50	--	--
09	HSMC	Design Thinking	1	-	-	1	1	--	--	--	CIE: 100	
10	AUD	*Mathworks certificate course on "Matlab Onramp"	0	0	0	2	0	--	--	--	--	
		Total	**14**	**01**	**06**	**09**	**20**					

***This is prerequisite for the fourth semester subjects Automatic Control System**

Semester -IV

Sr. No.	Course Type	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
								Theory			Laboratory	
								MSE	TA	ESE	ISE	ESE
01	PCC	Microcontrollers and Applications	3	0	2	1	4	30	20	50	50	50
02	PCC	Automatic Control System	3	0	2	1	4	30	20	50	50	50
03	PCC	Digital Electronics	3	0	2	1	4	30	20	50	50	50
04	VEC-2	Constitution of India	1	0	0	2	1	CIE: 100			--	--
05	PCC	Signals and Systems	2	1	0	1	3	30	20	50	--	--
06	OE	Principles of Electronic Communication	2	0	0	1	2	30	20	50	--	--
07	MD M	Multidisciplinary Minor - I	2	0	2	1	3	30	20	50	50	50
		Total	**16**	**01**	**08**	**08**	**21**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits, ISE-In-Semester-Evaluation, ESE-End-Semester-Evaluation, MSE-Mid-Semester-Evaluation, TA-Teachers' Assessment, CIE-Continuous-Internal-Evaluation

Exit option to qualify for UG Diploma:

- **Calibration and Testing (3 Credits)**
- **Programmable Logic Controller (3 Credits)**

S. Y. B. Tech. Instrumentation & Control Engineering

Semester –III (Lateral Entry (Diploma))

Sr. No.	Course Type	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
								Theory			Laboratory	
								MSE	TA	ESE	ISE	ESE
01	PCC	Sensors and Transducers	3	0	2	1	4	30	20	50	50	50
02	PCC	Analog Electronics	3	0	2	1	4	30	20	50	50	50
03	OE	Electrical Machines and Drives	2	0	0	1	2	30	20	50	--	--
04	ES-07	Numerical Methods	0	1	2	0	2					
05	HSMC	Indian language	2	0	0	1	2	CIE: 100			--	--
06	VEC	Environmental Studies	1	0	0	2	1	CIE: 100			--	--
07	CEA	Community Engagement Activity (CEA)/Field Project	-	-	-	-	2	--	--	--	CIE: 100	
08	HSMC	Entrepreneurship	2	0	0	1	2	30	20	50	--	--
09	HSMC	Design Thinking	-	-	2	1	1	--	--	--	CIE: 100	
10	AUD	*Mathworks certificate course on "Matlab Onramp"	0	0	0	2	0	--	--	--	--	
11	PCC	Mathematics	3	0	0	1	3	30	20	50		
	Total		**16**	**01**	**08**	**11**	**23**					

***This is prerequisite for the fourth semester subjects Automatic Control System**

Semester -IV

Sr. No.	Course Type	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
								Theory			Laboratory	
								MSE	TA	ESE	ISE	ESE
01	PCC	Microcontrollers and Applications	3	0	2	1	4	30	20	50	50	50
02	PCC	Automatic Control System	3	0	2	1	4	30	20	50	50	50
03	PCC	Digital Electronics	3	0	2	1	4	30	20	50	50	50
04	VEC-2	Constitution of India	1	0	0	2	1	CIE: 100			--	--
05	PCC	Signals and Systems	2	1	0	1	3	30	20	50	--	--
06	OE	Principles of Electronic Communication	2	0	0	1	2	30	20	50	--	--
07	MD M	Multidisciplinary Minor - I	2	0	2	1	3	30	20	50	50	50
		Total	**16**	**01**	**08**	**08**	**21**					

Semester - III

[PCC-03] Sensors and Transducers

Teaching Scheme
Lectures: 3 hrs/week
Practical: 2 hr/week
Self-study: 1 hr/week

Examination Scheme
MSE : 30 marks
TA: 20 marks
End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Describe working principles of various transducers/sensors [PEO1][PO1]
2. Interpret the characteristics of the transducers/sensors [PEO2][PO2]
3. List various standards used for selection of transducers/sensors [PEO2][PO3]
4. Select transducers/sensors for specific applications [PEO3] [PO6]

Unit 1 (8L)
Temperature Measurement: Introduction to sensors and its characteristics**,** selection criteria, standards and calibration, data acquisition, Importance of sensing and its use in data analytics, Temperature scales, classification of temperature sensors, standards, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD thermocouple, thermistor, radiation sensors (pyrometers).

Unit 2 (7L)
Pressure and Level Measurement: Definition, pressure scale, standards, working principle, types, materials, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, capacitive (delta cell), high-pressure sensors, low-pressure sensors, standards, working principle, types, materials, design criteria: float, displacers, bubbler, ultrasonic, microwave, radar, resistance, thermal, solid level detectors.

Unit 3 (7L)
Flow Measurement: Standards, working principle, types, materials, and design criterion: primary or quantity meters (positive displacement flow meter), secondary or rate meter (obstruction type, variable area type), electrical flow sensors (turbine type, electromagnetic type, and ultrasonic type), flow switches.

Unit 4 (7L)
Environmental sensors: pH sensors, Conductivity sensors, Humidity, turbidity, dissolved oxygen (DO) sensor, Biochemical oxygen demand (BOD) sensor, total dissolved oxygen (DO) sensor, Chemical Oxygen Demand (COD) sensor: working principles, types and applications

Unit 5 (7L)
Miscellaneous sensors: flame sensor, smoke sensor, motion sensor, leak detector, density, Viscosity: working principles, types and applications

Unit 6 (5L)
Advances in sensor technology: Smart sensors, MEMS, Nano sensors, semiconductor sensors, biosensors: Introduction and applications

Text books:

1. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.

2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. R. S, Khandpur, "Handbook of Analytical Instruments", Tata McGraw Hill Education, third edition., 2017.
5. R. Frank, "Understanding Smart Sensors", Artech house, second edition, 2000.

Reference Books:

1. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
2. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
3. Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
4. A. K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons, Eleventh ed., 2000.
5. R. K. Jain, "Engineering Metrology", Khanna Publisher, Delhi, Eighteenth ed.,2002.
6. Paul Chapman, "Smart Sensors" ISA series, 1996.

Sensors and Transducers Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hr / week	ISE: 50 Marks
	ESE: 50 Marks

Course Outcomes:

1. Identify various elements required for characterization of given transducers/sensors
2. Design and conduct experiments for measurement and characterization for different transducers/sensors.
3. Analyze and interpret sensor data of given transducers/sensors.

List of Experiments:

1. Identify various characteristics of sensors from given dataset.
2. Characterization and calibration of temperature measurement system. (Thermocouple, RTD and Thermistor).
3. Characterization of pressure and vacuum sensor.
4. Characterization and calibration of level sensors. (Capacitive, resistive, and radar level gauge)
5. Characterization and calibration of flow measurement system. (Orifice, Pitot tube, Venture)
6. Characterization and calibration of flow measurement system. (Turbine, Electromagnetic and Ultrasonic)
7. Study of the detectors. (leak detectors, flame detectors, smoke detectors)
8. Characterization and calibration of density and viscosity sensors.
9. Characterization and calibration of pH
10. Characterization and calibration of conductivity
11. Characterization and calibration of turbidity
12. Maintenance and fault findings of various sensors.

[PCC-04] Analog Electronics

Teaching Scheme
Lectures: 3 hrs/week
Practical: 2 hr/week
Self-study: 1 hr/week

Examination Scheme
MSE : 30 marks
TA: 20 marks
End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Analyze** transistor circuit using h parameter model.
2. **Design and analyze** different op-amp circuits for various applications.
3. **Describe** the characteristics of various power devices and power converters.
4. **Select** a particular power device and power converter for specific application

Unit 1 **(07L)**

Transistor and operational amplifier: Transistor biasing, H parameters, two port analysis, Analysis of transistor configurations, Parameters, comparison of parameters; Current Mirrors Circuit, Class A, B and AB amplifiers, Class C amplifier, Power amplifiers, Servo amplifiers, Applications of Amplifiers.

Unit 2 **(08L)**

Operational Amplifiers: Op-Amp parameters, frequency response, effect of temperature on Op-Amp parameters, differential versus single input amplifiers, instrumentation amplifier, Instrumentation amplifier ICs, Rubric for selection of Instrumentation amplifier ICs, bridge amplifier, differentiator, integrator, comparators, V to I and I to V Converters, Miller circuits, Voltage controlled oscillators, PLL and its applications, Signal conditioning circuits for temperature transmitter, design of Oscillator's - LC and RC

Unit-3 **(06L)**

Signal Generators and filters: Multi vibrators, triangular wave generator, sawtooth wave generator, square wave generator, sine wave generator, Bootstrap / Sweep generator, Basics of filters, low pass& high pass Butterworth filters, band pass, band reject filters, filter specifications, and applications of filters

Unit-4 **(06L)**

Power devices and Applications: SCR, Triac, DIAC, UJT, MOSFET, IGBT Characteristics and principal of operation, Switching Characteristics, triggering requirement, protections, Performance specifications and applications.

Unit-5 **(06L)**

Regulators: Line and load regulation, characteristics of regulators, voltage multipliers, three terminal regulators, fixed and variable voltage regulators, current boosters, protection circuits for regulators, High and low current power supply design, Types of batteries, Criteria's for selection of batteries, Design of battery charging circuits

Unit-6 **(06L)**

Power Converters: SMPS, working principles, performance parameters, DC-DC converters- different types, working principles, analysis and applications.

Text Books

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education, 10th ed., 2009.
2. Ramakant Gayakwad, "Op-Amp and Linear Integrated Circuits", PHI, 4th ed.,2021.

Reference Books

1. George Clayton and Steve Winder, "Operational Amplifiers", Newnes Publishers, 5^{th} ed., 2003.
2. M. Rashid, "Power Electronics Circuit, Devices and Applications" Pearson Education, 3^{rd} ed. 2004.

Analog Electronics Laboratory

Teaching Scheme
Practical: 2 hr / week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks

Course Outcomes:

1. Design an experimental setup for measurement of transistor and operational amplifier's parameters.
2. Design and implement op-amp circuits for specific applications.
3. Plotting and analyzing characteristics of power devices and its usage for typical applications.

List of Experiments (Any 10 Experiments)

1. Design and Implementation of transistor biasing circuits.
2. Measurement of op-amp parameters.
3. Design and implementation of integrator, differentiator, and comparators.
4. Design and implementation of Instrumentation amplifier.
5. Design and implementation of voltage multiplier.
6. Design of Oscillator circuits- LC and RC.
7. Design and implantation of voltage-controlled oscillator and its practical applications.
8. Design and implementation of phase locked loop and its applications.
9. Design and implementation of various signal generators.
10. Design of low pass and high pass filter.
11. Study, plot and analyze characteristics of DIAC and SCR.
12. Study, plot and analyze characteristics of BJT, UJT and MOSFET.
13. Study of UJT as relaxation oscillator.

[ES-07] Numerical Methods

Teaching Scheme
Tutorial: 1 hrs/week
Practical: 2 hr/week
Self-study: 1 hr/week

Examination Scheme
MSE : 30 marks
TA: 20 marks
ESE: 50 marks

Course Outcomes:

1. Be familiar with the use of numerical methods in modern scientific computing [PEO1][PO1]
2. Be familiar with finite precision computation. [PEO1][PO1]
3. Be familiar with numerical solutions of nonlinear equations in a single variable [PEO1][PO1]
4. Be familiar with numerical integration and differentiation[PEO1][PO4]
5. Ability to determine different methods of numerical interpolation and approximation of functions. [PEO3][PO3

Unit I:
Linear and Non-linear equations: Iterative method for solution of system of linear equations Jacobi and Gauss Seidel method. Solution for transcendental equations, Bisection Method, Secant method, Newton-Raphson method

Unit II:
Interpolation: error terms. Uniqueness of interpolating polynomial. Newton's fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration, Lagrange method

Unit III:
Numerical integration and differentiation: Trapezoidal rule, Simpson's rule, method of undetermined coefficients, Gaussian rule, approximation of first derivative methods based on interpolation

Unit IV:
Numerical ordinary differential equations and partial differential equations: Eular's method, Modified Eular's method, Runge-Kutta Method, Finite-difference approximation. Explicit methods

List of Experiments:

1. **Roots of Non-Linear Equations**-To find the roots of non-linear equations usin Bisection method.
2. **Roots of Non-Linear Equations** -To find the roots of non-linear equations usin Newton-Raphson method.
3. **Interpolation**- Using Linear or Quadratic interpolation, finds intermediate data point from given set of data.
4. **Interpolation**- Using Lagrange interpolation, find intermediate data point form given se of data and compare the result with linear or quadratic interpolation.

5. **Curve Fitting**- For a give data set; find best fit curve using linear regression
6. **Curve Fitting**- For a give data set; find best fit curve using polynomial regression.
7. **Linear Solver**-To solve system of linear equations using Gauss Elimination method.
8. **Linear Solver**-To solve system of linear equations using Gauss Jordan method.
9. **Integration**-To integrate numerically using Trapezoidal Rule.
10. **Integration**-To integrate numerically using Simpson's Rule.
11. **Matrix Eigen values**-To find Eigen values of matrix by power method
12. **Differential Equation**-To find numerical solution of ordinary differential equations by Euler's methods.
13. **Differential Equation**-To find numerical solution of ordinary differential equations by Runge- Kutta methods.

Test Books:

1. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 7th Edition, McGraw-Hill
2. Steven C. Chapra, Applied Numerical Methods with Matlab for Engineers and Scientist McGraw-Hill

Semester - IV

[PCC-05] Microcontrollers and Applications

Teaching Scheme
Lectures: 3 hrs/week
Practical: 2 hr/week
Self-study: 1 hr/week

Examination Scheme
Midsem : 30 marks
TA: 20 marks
End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will be able to

1. Differentiate amongst various architectures of microcontrollers
2. Impart microcontroller programming and design skills.
3. Undertake problem identification formulation and selection of appropriate microcontroller as per the applications
4. Interface and use different peripherals with microcontrollers
5. Compare and analyze different microcontrollers for the real world applications
6. Evaluate and compare the performance of microcontrollers

Unit 1 **(8 hrs)**
Introduction to Microcontroller:
Numbering system, Microcontrollers Vs Microprocessors, RISC and CISC architecture comparison. Von-Neumann vs. Harvard architecture, comparison between 8-bit, 16-bit, 32-bit microcontroller. Stack and use of stack pointer. Memory structure, Data Memory, Program Memory and execution of programs.

Unit 2 **(8 hrs)**
Programming with microcontroller:
Programming: Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator. Instruction set, basic programming using assembly instructions. Introduction to embedded-C, Integrated Development Environment (IDE), cross compiler, ISP, software delay generation.

Unit 3 **(8 hrs)**
8 Bit micro-controller:
Introduction to 8 bit microcontroller, Addressing Modes & Instruction Set, architecture and PIN description, Interrupts and Operating Modes, Analog Input-Output and PWM, Digital Input-Output, Memory Mapping (internal as well as external) of microcontroller.

Unit 4 **(6 hrs)**
I/O Interfacing:
I/O programming, interfacing with simple switch, LED, Keypad programming. Timers, various modes of operations of timers, counters, PWM programming.

Unit 5 **(6 hrs)**
Communication Protocols:
Serial peripheral interface (SPI), SPI based memory interfacing, Universal Serial Communications Interface (USCI) interfacing and programming, Interrupt understanding and interfacing, I2C based RTC interfacing , WDT (Watch dog timer).

Unit 6

External Peripheral Interfacing: (6 hrs)

Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), Interfacing with DAC, Interfacing with stepper motor and DC motor, Comparative analysis of different 8 bit microcontrollers.

Text Books:

- Mazidi, "8051 microcontroller & embedded system" 3rdEdition ,Pearson
- Mazidi, "PIC microcontroller & embedded system" 3rdEdition ,Pearson
- Kenneth J. Ayala, "8051 Microcontroller: Programming, Architecture and Interfacing", Thomas Delmar Learning, Third ed., 2007.
- Newnes, 1st Edition, 2010 "MSP430 Microcontroller Basics" by John H Davies

Reference Books:

- Kenneth J. Ayala, "The 8051 Micro-controller – Architecture, Programming & Applications", Penram International & Thomson Asia, Second Edition.
- John B. Peatman, "Design with PIC Micro-controllers", Pearson Education Asia, Low Price Edition
- MSP430 Technical Reference Manual
- Newnes Publication, 2009 *Texas Instruments MSP 430 microcontroller, Guide and Datasheet
- Muhammad A. Mazidi, "AVR Microcontroller and Embedded Systems: Assembly and C", Pearson; 1st edition, 2015

Microcontrollers and Applications Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hr / week	ISE: 50 Marks
	ESE: 50 Marks

Course Outcomes:

1. Understand and apply the fundamentals of assembly/embedded 'c' level programming of microprocessors and microcontroller
2. Analyze problems and apply a combination of hardware and software to address the problem.

List of Experiments

Design build and test the circuits of ---

1. GPIO toggling.
2. Seven segment LED interfacing with microcontroller
3. Keypad interfacing with microcontroller.
4. ADC interfacing with microcontroller with the help of waveform generation.
5. Timers and counters.
6. UART interfacing.
7. Interrupts in microcontrollers.
8. PWM generation using a microcontroller.
9. DC/stepper motor interfacing with a microcontroller.
10. I2C and SPI based peripheral interfacing.

[PCC-06] Automatic Control System

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	Midsem : 30 marks
Practical: 2 hr/week	TA: 20 marks
Self-study: 1 hr/week	End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Develop** mathematical model of Electrical and Mechanical system using differential equations and transfer function and develop analogy between Electrical and Mechanical systems.
2. **Determine** time response of systems for a given input and perform analysis of first and second order systems using time domain specifications.
3. **Investigate** closed loop stability of system in s-plane using Routh Hurwitz stability criteria and root locus.
4. **Analyze** the systems in frequency domain and investigate stability using Nyquist plot and Bode plot

Unit 1 **(10L)**

Basics of Control System: Basic concepts of control system, classification of control systems, types of control system: feedback, tracking, regulator system, feed forward system, transfer function, concept of pole and zero, modeling of Electrical and Mechanical systems (Only series linear and rotary motion) using differential equations and transfer function , analogy between electrical and mechanical systems, block diagram algebra, signal flow graph, Mason's gain formula

Unit 2 **(10L)**

Time domain analysis: Concept of transient and steady state response, standard test signals: step, ramp, parabolic and impulse signal, type and order of control system, time response of first and second order systems to unit impulse, unit step input, time domain specifications of second order systems, derivation of time domain specifications for second-order under-damped system for unit step input, steady state error and static error coefficients

Unit 3 **(10L)**

Stability analysis and Root Locus: Concept of stability: BIBO, nature of system response for various locations of poles in S-plane, Routh's-Hurwithz criterion. Root Locus: Angle and magnitude condition, Basic properties of root locus. Construction of root locus, Stability analysis using root locus.

Unit 4 **(10L)**

Frequency domain analysis: Introduction to Frequency domain specifications, correlation between time and frequency domain specifications, polar Plot, Nyquist plot, stability analysis using Nyquist plot. Introduction to Bode plot, Asymptotic approximation: sketching of Bode plot, stability analysis using Bode plot

Automatic Control System Laboratory

Teaching Scheme
Practical: 2 hr / week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks

Course Outcomes:

1. Analysis and validation of time domain response for 1^{st} & 2^{nd} order system
2. Experimental validation of mathematical model
3. Write a program for validation of different control strategies

List of Experiments:

1. Transfer function of RC System and its step response.
2. Transfer function of RLC System step response.
3. Study of first and second order system response and find its time constant and verify it, Theoretically.
4. Find steady state error of Type 0, 1, 2 systems.
5. Study of under damped, over damped and critically damped response of second order system (RLC ckt) and theoretically verify it
6. Find TF of two RC n/w using Bode plot
7. Introduction to Control System Toolbox in MATLAB.
8. Introduction to Simulink (Basic blocks used in Control system).
9. Calculation of time domain specifications using MATLAB.
10. Stability analysis using root locus approach.
11. Stability analysis using frequency response approach (Bode plot approach)

Text Books

1. I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 6th edition, 2017.
2. R. Anandanatrajan and P.Ramesh Babu, "Control Systems Engineering", Scitech Publication,3rd edition, 2011
3. D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005.
4. Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.

References Books

1. B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
2. Van de Vegte, John. *Feedback Control Systems*. 3rd ed. Prentice Hall, 1994.
3. Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011
4. Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.
5. Ogata, Katsuhiko. *Solving Control Engineering Problems with MATLAB*. Prentice Hall, 1993.

[PCC-07] Digital Electronics

Teaching Scheme
Lectures: 3 hrs/week
Practical: 2 hr/week
Self-study: 1 hr/week

Examination Scheme
Midsem : 30 marks
TA: 20 marks
End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Describe** various logic families and select a logic family logic gate(s) for a typical application
2. **Apply** Boolean algebra and other minimization techniques to digital circuits.
3. **Design** combinational and sequential circuits for a given problem / case studies related to digital circuits.
4. **Evaluate** appropriate hardware and software tools for combinational and sequential circuit design, implementation and verification.

Course Contents:

Unit 1 **(06L)**

Logic Families: Digital IC specification terminology, different types of logic families, complementary metal oxide semiconductor logic, logic families interfacing – TTL driving CMOS, CMOS driving TTL, measurement of specification parameters of IC's, 5400 /7400 series ICs, Tristate Logic, Comparison of Different logic families.

Unit 2 **(06L)**

Combinational Circuits: Introduction to Combinational circuits, analysis procedure, design procedure, Boolean algebra, Kmap, Tabular method, binary adder, binary subtractor, decimal adder and their implementation, binary multiplier, magnitude comparator, decoders, encoders, multiplexer, hardware design logic for combinational circuits, Combinational Logic design using MSI Circuits, Hazards in Combinational circuits.

Unit 3 **(07L)**

Sequential Circuits: Flip Flops, Conversion of flip flops, ripple counters, synchronous counters, Hardware for counters , Ring, Johnson, Binary, BCD, Up-Down counters and its applications, registers, shift registers and their applications, Hardware design logic for counters, Hazards in sequential Circuits

Unit 4 **(07L)**

Analysis of sequential circuits: Synchronous and Asynchronous Sequential Logic: Sequential circuits, latches, analysis of clocked sequential circuit, hardware design logic for sequential circuits, state reduction, State diagram, and state equation, Asynchronous logic, circuits with latches, design procedure, reduction of state and flow tables, race free state assignments, design examples

Unit 5 **(06L)**

Programmable Logic Devices I: Introduction to memories, Types of memories, Memory specification, Introduction to PAL, PLA, Configurable Programmable Logic Devices, Various types of CPLD's.

Unit 6 **(07L)**

Programmable Logic Devices II: Introduction to FPGA and its various architectures, PLD Programming concepts, Introduction to PLD Programming languages, Realization of combinational and sequential circuits on PLDs.

Test Books

1. Ronald J. Toccii, "Digital Systems: Principles and Applications", Pearson LPE, Fourthed. 2009
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Higher Education, Fourth ed.,2010

Reference Books:

1. Mano M.M, "Digital Logic and Computer Design", Pearson LPE, Fourth, ed., 2009.
2. Boyce J. C., "Digital Logic: Operation and Analysis", Prentice Hall, Second ed., 1982

Digital Electronics Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hr / week	ISE: 50 Marks
	ESE: 50 Marks

Course Outcomes:

1. Design experimental setup for measurement of digital IC parameters & its verification.
2. Design, realize and analyze various combinational and sequential circuits
3. Select and use latest hardware and software tools for digital system realization.

List of Experiments:

1. Measurement of IC's parameters like rise time, fall time, propagation delays, and current and voltage parameters.
2. Design and implementation of arithmetic circuits.
3. Design and implementation of various code converters and its applications.
4. Design and implementation of multiplexer and demultiplexer and its applications.
5. Design and implementation of encoders and decoders and its applications.
6. Design and implementation of synchronous and asynchronous counters and its applications.
7. Design and implementation of non-sequential counters.
8. Design and implementation of shift registers and its applications.
9. Implementation and verifications of Combinational circuits on programmable logic devices.
10. Implementation and verifications of sequential circuits on programmable logic devices

[PCC-02] Signals and Systems

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs/week	Midsem : 30 marks
Tutorial: 1 hr/week	TA: 20 marks
Self-study: 1 hr/week	End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Classify signals based on their characteristics and perform basic operations on signals.
2. Interpret system characteristics and analyze LTI systems.
3. Analyze the spectral properties of signals using Fourier analysis.
4. Apply Z- transform to study discrete-time signals and systems.

Course Contents:

Unit-1: Introduction to Signals (05 L)

Definition of Signals, Classification of Signals, elementary signals, basic operations on signals

Unit-2: System Classification and Properties (06 L)

Introduction to Systems, Classification of Systems, Properties of Systems, Impulse response characterization and convolution for CT- LTI and DT-LTI systems, LTI systems characterized by Differential and difference equations

Unit-3: Fourier analysis of Continuous Time Signals (06 L)

Fourier analysis for Continuous time signals, Continuous time Fourier Transform, its properties, frequency response.

Unit-4: Fourier Analysis of Discrete Time Signals (05 L)

Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response.

Unit-5: Z-Transform (05 L)

Representation of Signals Using Discrete-Time Complex Exponentials: Z-Transform, Significance and Properties of Region of Convergence, Properties of Z-Transform, Inverse Z-Transform, relationship of z-transform with Fourier transform, applications of Z-transform to solutions of difference equations, Properties of Z transform

Test Books:

1. Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley and sons

2. Michael J. Robert, "Introduction to Signals and Systems", TMH, Second ed., 2003

3. Tarun Kumar Rawat "Signals and Systems", Oxford University Press, first edition 2010

Reference Books:

1.Alan V Oppenhein, Alan S Wiilsky, "Signals and systems" PHI, Second ed. 2009

2. Shaila Dinkar Apte "Signals and Systems: Principles and Applications", Cambridge University Press.

Multidisciplinary Minor

[MI-01] Measurement Techniques

Teaching Scheme
Lectures: 3 hrs/week
Self-study: 1 hr/week

Examination Scheme
Midsem : 30 marks
TA: 20 marks
End Sem. Exam: 50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

- Describe working principles of various measuring instruments [PEO1][PO1]
- Interpret the characteristics of the transducers/sensors [PEO2][PO2]
- Identify various blocks of electronic instruments for measurement and testing
- Select appropriate electronic instrument for specific applications [PEO3] [PO6]

Course Contents:

Unit-1: Measurement System and Electrical Transducers (08 L)

Measurement system: Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, Importance of sensing. Electrical transducers for measuring flow , temperature, level, pressure etc.

Unit-2: Signal Conditioning (05 L)

Introduction, Block diagram of data acquisition and signal processing system, Signal Amplification, Noise Attenuation, Signal Filtering, Analysis of signals, Data converters,

Unit-3: Digital instruments (08 L)

Role of digital instruments in measurement system, Advantages of Digital instruments over Analog instruments, Block diagram, principle of operation, significance of digit, Automation in digital instruments , Universal counter and their applications like event, ratio, totalizing and timers Digital Multimeter

Unit-4: Recording & Integrating instruments (07 L)

Role of recording instruments in measurement system, General purpose oscilloscope Block Diagram, Cathode Ray Tube, deflection sensitivity, front panel controls, Oscilloscope Probes 1:1 and 10:1, Dual trace CRO, ALT and CHOP modes, measurement of electrical parameters like voltage, current, frequency and phase, frequency measurement by Lissajous pattern, Digital Storage oscilloscope block diagram, sampling rate, bandwidth, roll mode

Text Books:

- David Bell; "Electronic Measurement and Instrumentation" Prentice Hall 2nd ed. 2000.
- A.J. Bowens; "Digital Instrumentation" McGraw-Hill, 1st ed. 1986
- C.S. Rangan, G.R. Sarma, V.S.V. Mani; "Instrumentation Devices and Systems "Tata McGraw Hill 2nd ed. 1997.

Reference Books:

- J.J.Carr; "Elements of Electronic Instrumentation and Control" Prentice Hall 3rd ed. 2009.
- W.Cooper, A.Helfric; "Electronic Instrumentation and Measurement Techniques "PHI 3rd ed. 2005