CURRICULUM STRUCTURE OF S. Y. B. TECH(Instrumentation &Control)

Effective from Academic Year 2016-2017

Semester III [E-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC		Multivariate Calculus	2	1	0	3
			Linear Algebra & Univariate Calculus*	4	1	0	5
2	MLC	ML-16001	Professional Ethics & Values	1	0	0	0
3	HSMC	HS-16001	Innovation	1	0	0	1
4	PCC	IE-16002	Transducer I	3	0	0	3
5	PCC	IE-16003	Analog Techniques	3	0	0	3
6	PCC	IE-16004	Electrical Measurement & Instrumentation	3	0	0	3
7	LC	IE-16005	Transducer I Laboratory	0	0	2	1
8	LC	IE-16006	Analog Techniques Laboratory	0	0	2	1
9	LC	IE-16007	Electrical Measurement & Instrumentation Laboratory	0	0	2	1
10	SBC	IE-16001	Computational Techniques I Laboratory	0	2	2	3
				13	03	08	19
			Total Academic Engagement and Credits	**24**			**19/24***

* For Diploma students

Semester IV [E-Group]

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	BSC	MA-16005	Differential Equations	2	1	0	3
		MA-16006	Multivariate Calculus & Differential Equations*	4	1	0	5*
2	BSC	AS-15003	Applied Biology	3	0	0	3
3	HSMC	HS-08001	Entrepreneurship Development	1	0	0	1
4	ILOE		Institute Level Open Elective [of Type EFC] [To be offered to other Departments] Engineering Instrumentation	3	0	0	3
5	PCC	IE-16008	Transducer II	3	0	0	3
6	PCC	IE-16009	Digital Techniques	3	0	0	3
7	PCC	IE-16010	Automatic Control System	3	0	0	3
8	LC	IE-16011	Transducer II Laboratory	0	0	2	1
9	LC	IE-16012	Digital Techniques Laboratory	0	0	2	1
10	LC	IE-16013	Automatic Control System Laboratory	0	0	2	1
11	SBC	IE-16014	Numerical Methods Laboratory	0	1	2	2
				18	2	8	24
			Total Academic Engagement and Credits	**28**			**24/26***

* For Diploma students

IE Transducers I

Teaching Scheme:
Lectures :3hrs/week

Examination Scheme:
Assignments/Quiz/T1/ T2-40,
End Sem. Exam.– 60

Unit 1 **(6hrs)**

Introduction: 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, standards and calibration.

Unit 2 **(7hrs)**

Temperature measurement: Temperature scales, classification of temperature sensors, standards, working principle, types, materials, design criterion: Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistor), radiation sensors (pyrometers), Temperature switch.

Unit 3 **(7hrs)**

Pressure measurement: Definition, pressure scale, standards, working principle, types, materials, design criterion: Manometers, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, force balance type, motion balance type, capacitive (delta cell), ring balance, vibrating cylinder type, high-pressure sensors, low-pressure sensors, Pressure switch.

Unit 4 **(7 hrs)**

Level measurement: Standards, working principle, types, materials, design criterion: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, TDR/ PDS type, solid level detectors, fiber optic level detectors, Level switches.

Unit 5 **(8hrs)**

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 6 **(5 hrs)**

Chemical sensors: Standards, working principle, types, materials, and design criterion: Chemical sensors (pH and conductivity).

Course Outcomes:

i. Describe working principles of various transducers/sensors [PEO1][PO-a]
ii. Interpret the characteristics of the transducers/sensors [PEO3][PO-b]
iii. List various standards used for selection of transducers/sensors [PEO2][PO-c]
iv. Select transducers/sensors for specific applications [PEO3] [PO-l]

Text Books:

- D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

- B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
- E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
- Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
- A. K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons, Eleventh ed., 2000.

IE Analog Techniques

Teaching Scheme:
Lectures : 3hrs/week

Examination Scheme:
100 marks: T1/ T2/ Assignments/Quiz-40
End Sem. Exam.– 60

Unit 1 **(8 hrs)**

Transistor: Transistor biasing , Hybrid h parameter model and two port model applied to BJT, Analysis of common emitter, common collector and common base configurations- voltage and current gain, input and output impedance, comparison of properties; Current Mirrors Circuit, Class A, B and AB amplifiers, Class C amplifier, Power amplifiers, Servo amplifiers, Applications of Amplifiers.

(8hrs)

Unit 2

Operational Amplifiers: Op-Amp parameters, frequency response, effect of temperature on Op-Amp parameters, differential versus single input amplifiers, instrumentation amplifier, bridge amplifier, adding versatility to the 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 using OP amps.

Unit 3 **(7 hrs)**

Signal Generators and filters: Multivibrators, triangular wave generator, sawtooth wave generator, square wave generator, sine wave generator, Bootstrap Sweep generator, basic low pass filters, low pass and high pass Butterworth filters, band pass, band reject filters, applications of filters.

Unit 4 **(7 hrs)**

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

Unit 5 **(5 hrs)**

Regulators: Line and load regulation, characteristics of regulators, voltage multipliers, three terminal regulators, current boosters, protection circuits for regulators, power supply design, battery charging circuits.

Unit 6 **(5 hrs)**

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

Course Outcomes:

i. Analyze transistor circuit using h parameter model. [PEO1][PO-c]

ii. Design and analyze different op-amp circuits for various applications. [PEO2][PO-e]

iii. Describe characteristics of various power devices and power converters [PEO1][PO-c]

Text Books:

- Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education, Tenth ed., 2009.
- Ramakant Gayakwad, "Op-Amp and Linear Integrated Circuits", PHI,Forth ed.,2000.

Reference Books:

- George Clayton and Steve Winder, "Operational Amplifiers", Newnes Publishers, Fifth ed., 2003.
- M. Rashid, "Power Electronics Circuit, Devices and Applications "Pearson Education, Third ed. 2004.

IE Electrical Measurements and Instrumentation

Teaching Scheme:
Lectures:
3hrs/week

Examination Scheme:
T1/T2/Assignments/Quiz-40,
End Sem. Exam.- 60

Unit 1 **(7hrs)**

Analog meters: Electromechanical meters, PMMC type, galvanometer, DC ammeter, DC voltmeter, calibration, selection and performance of measuring instruments, multi-range meters, extension of range, loading effect in instruments.

Unit 2 **(8hrs)**

Resistance Measurement: Wheatstone bridge, arrangement of ratio arms, sensitivity, errors, null type and deflection type, calibration adjustment, Kelvin bridge, Kelvin double bridge, series ohmmeter, shunt ohmmeter, DMM.

Unit 3 **(7hrs)**

Inductance and Capacitance Measurement: Maxwell's bridge: design and applications, Hay's bridge: design and applications, Schering bridge: design and applications, LCR Q-meter.

Unit 4 **(7hrs)**

Digital Instruments: ADC, DAC, circuitry and operation, specifications, applications of ADC and DAC, DMM, true RMS meter, Universal Counter, DSO.

Unit 5 **(6hrs)**

Energy and Power Measurement: Electrodynamometer, moving iron type, measurement of power in ac circuits and dc circuits, smart energy meter, introduction to smart power measurement system.

Unit 6 **(5 hrs)**

Signal generators and analyzers: function generator, sine wave synthesis, arbitrary waveform generators, total harmonic distortion analyzer

Course Outcome:

i. Describe working principles of instruments for measurement of electrical quantities [PEO1] [PO-a]

ii. Identify and evaluate bridges for measurement of R, L and C [PEO2] [PO-b]

iii. Describe working principles of instruments for power, energy and signal analyzers [PEO1] [PO-a]

Text Books:

- A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
- David Bell, "Electronic Measurement and Instrumentation", Prentice Hall, Second ed., 2007.

Reference Books:

- J. Bouwens, "Digital Instrumentation", McGraw-Hill, Sixteenth reprint, 2008.
- H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, Third ed., 2010.
- Albert D. Helfrick, William David Cooper, "Modern electronic Instrumentation and Measurement Techniques" Prentice Hall, Second ed., 1990.
- Clyde F. Coombs, "Electronic Instrument Handbook", McGraw-Hill, Third ed., 2000.
- Wolf, Richard F. M. Smith Stanley, "Electronic Instrumentation Laboratories", Prentice Hall, Second ed., 2004.

IE Computational Techniques

Teaching Scheme:
Tutorial: 1hrs/week
Practical: 3hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam. - 50

The main topics are: MATLAB basics, writing m-file, root finding, plotting, matrix and vectorization, parameterized functions, reading and writing a data, file handling, Simulink, embedded functions, GUI

List of Experiment:

1. **MATLAB Basics:** MATLAB introduction and use of command window as a calculator. Arithmetic operations. Looping and control structures.
2. **Writing m-file:** Write a m-file with use of *for loop* and *while loop*
3. **Root finding:** Write a program to solve system of nonlinear equations using Newton's method/Secant method and compare the result with in-built command *fsolve.*
4. **Solution of ODE**: Write a program to solve system of ordinary differential equations and compare the solution with in-built command *ODE45* and for symbolic solution using *dsolve.*
5. **Plotting**: X-Y plotting functions, subplots, interactive plotting, regression, 3-D plots. Write a program to solve system of non-linear equations and plot the solution process.
6. **Matrix and Vectorization:** Entering matrix and vectors, column and row operation with matrix, matrix operations and commands related to matrix operations. Write a program to find inverse of a given matrix or solution of linear system, compare the result with in-built command *inv* and *linsolve*
7. **Parameterized functions:** Writing a basic function, passing parameters in function, passing function in a function.
8. **Data and file handling**: Data types and data manipulations, reading from and writing to external text files. Importing data from spreadsheets. Reading images.
9. **Simulink:** Introduction to Simulink, creating simple feedback model in Simulink. Input and output blocks, scope.
10. **Embedded function block:** Writing a function and importing in s Simulink blocks.
11. **GUI:** Creating a simple GUI in Matlab for radio buttons, bars, panels, etc.

Course Outcomes:

i. Demonstrate the proficiency of engineering computational platforms. [PEO1] [PO-a]

ii. Write algorithms to solve different arithmetic with MATLAB platform. [PEO2][PO-k]

iii. Write algorithms to solve different special logical arithmetic with MATLAB toolboxes. [PEO1] [PO-l]

IE Transducers I Laboratory

Teaching Scheme:
Practical :2hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam. – 50

List of Experiment:

1. Characterization and calibration of temperature measurement system. (Thermocouple, RTD and Thermistor).
2. Calibration of pressure gauges.
3. Calibration of vacuum gauges.
4. Characterization and calibration of level measurement system. (Capacitive, resistive, and radar level gauge)
5. Characterization and calibration of flow measurement system. (orifice and venture)
6. Characterization and calibration of flow measurement system (turbine, electromagnetic and ultrasonic).
7. Characterization and calibration of chemical sensors (pH and conductivity).
8. Identification of a temperature sensor from the list, which has minimum response time.
9. Select a pressure sensor for the application which needs highest accuracy
10. Identify a flow sensor from the list which exhibits best dynamic characteristics

Course Outcomes:

i. Identify various elements required for characterization of given transducers/sensors. [PEO2][PO-e]
ii. Design and conduct experiments for measurement, characterization, and ability to analyze and interpret data. [PEO1] [PO-b]
iii. Communicate effectively in oral and written form while formulating experiments, reports and other related documents. [PEO3][PO-g]

IE Analog Techniques Laboratory

Teaching Scheme:
Practical : 2 hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam.- 50

List of Experiment:

1. Measurement of op-amp parameters.
2. Design and implementation of integrator, differentiator and comparators.
3. Design and implementation of Voltage Controlled Oscillator and its practical applications.
4. Design and implementation of Phase Locked Loop and its applications.
5. Design and implementation various signal generators.
6. Design and implementation of instrumentation amplifier.
7. Design and implementation of voltage multiplier.
8. Study, plot and analyze characteristics of Diac and SCR.
9. Study, plot and analyze characteristics of BJT, UJT and MOSFET.
10. Design and implementation of voltage regulator.

Course Outcomes:

i. Identify and measure transistor and operational amplifier's parameters [PEO1][PO-a]
ii. Design and implement various circuits using op-amp for various applications. [PEO2][PO-b]
iii. Plotting and analyzing characteristics of power devices and its applications. [PEO1][PO-b]

IE Electrical Measurements and Instrumentation laboratory

Teaching Scheme:
Practical : 2hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam. – 50

List of Experiment:

1. Conversion and extension of PMMC type instruments.
2. Design and implementation of resistance measurement using Wheatstone bridge and validation using V-I method and LCR meter
3. Design and implementation of series and shunt ohmmeters and evaluate its performance.
4. Design of Schering and Maxwell bridges for measurement of inductance and capacitance and validation using LCR – Q meter.
5. Design and implementation of DAC using R-2R ladder network.
6. Design and implementation of ADC using IC 0808/0809
7. Study of DSO control panel and its specifications. Implement applications of DSO.
8. Implementation of Virtual instrumentation for energy, power, power factor measurement.
9. Implement and analyse signal generator using virtual instrumentation.
10. Implement and analyse signal analyser using virtual instrumentation.

Course Outcomes:

i. Design and implement experimental setup for measurement of electrical quantities. [PEO1] [PO-b]
ii. Design and implement experimental setup for measurement of analog and digital signals. [PEO2][PO-b]
iii. Demonstrate the usage of energy, power meters and signal analyzers. [PEO2] [PO-c]

IE Transducers II

Teaching Scheme:
Lectures :3hrs/week

Examination Scheme:
100 marks: Assignments/Quiz/T1/ T2-40
End Sem. Exam. - 60

Unit 1 **(8hrs)**

Displacement Measurement: Resistive: Potentiometer, Linear and rotary, Loading Effect types of strain gauges. Inductive: LVDT and Eddy current type Transducers. Capacitive: Capacitance pickups, Differential capacitive cells. Piezoelectric, Ultrasonic transducers and Hall effect transducers Optical transducers. Precision measuring instrument (gauges), Applications of displacement sensors

Unit 2 **(6hrs)**

Velocity and speed measurement: Standards, working principle, types, materials, design criterion: Moving magnet and moving coil, Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, Shaft speed measurement. Applications of velocity measurement sensors.

Unit 3 **(7 hrs)**

Vibration and acceleration measurement: Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type. Applications of Acceleration and vibration sensors.

Unit 4 **(7hrs)**

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. Applications of Force and Torque sensors.

Unit 5 **(6hrs)**

Allied Sensors: Standards, working principle, types, materials, design criterion: leak detector, flame detector, smoke detector, humidity, density, viscosity sensors, and digital transducers, Sound sensors, and Proximity sensors.

Unit 6 **(6 hrs)**

Advances in sensors technology: Working Principle, types, Materials: Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Course Outcomes:

i. Describe working principles of various transducers/sensors [PEO1][PO-a]
ii. Interpret the characteristics of the transducers/sensors [PEO3][PO-b]
iii. Select transducers/sensors for specific applications [PEO3] [PO-l]
iv. Describe latest technologies used for development of advanced transducers/sensors [PEO3][PO-j]

Text Books:

- D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

- B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Fourth ed., 2003.
- E.O. Doebelin, "Measurement Systems", McGraw Hill, Fifth ed., 2003.
- Sabrie Soloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
- A. K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons, Eleventh ed., 2000.
- R.K.Jain, "Engineering Metrology", Khanna Publisher, Delhi,Eighteenth ed.,2002.

IE AUTOMATIC CONTROL SYSTEM

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Assignments/Quiz/T1/ T2-40
End sem. Exam – 60 marks

Unit 1 **[07 hrs]**

Review of Laplace and inverse Laplace transform, Introduction to control systems, Introduction to design process, classification of control system, modeling of mechanical, electrical, electromechanical systems.

Unit 2 **[07 hrs]**

Block diagram reduction techniques, signal flow graph, Mason's gain formula, signal flow graph from block diagram

Unit 3 **[08 hrs]**

Time response analysis, 1st, 2nd and higher order systems, effect of addition of poles and zeros, steady state errors (SSE) for feedback systems, static error constants and system types, steady state errors for external disturbances. Design of system parameters from SSE

Unit 4 **[05 hrs]**

Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and Performance analysis

Unit 5 **[05 hrs]**

Root locus techniques, Root locus construction rules, Sketching of Root Locus

Unit 6 **[08 hrs]**

Frequency response analysis, Bode plot, Asymptotic approximations and refining of plot, Gain Margin, Phase Margin via Bode plot, Polar plot, Nyquist plot, Stability, Gain Margin, Phase Margin via Nyquist plot.

Course Outcomes:

i. Describe elements of control system. [PEO1] [PO-a]
ii. Design mathematical model for electrical, mechanical and electromechanical system. [PEO2] [PO-e]
iii. Application of basic methods for analysis of control systems. [PEO1][PO-b]

Text Books:

- Norman Nise, Control System Engineering, Wiley International, sixth edition, 2011
- Nagrath and Gopal, Control System Engineering-, New Age International Publication, fifth edition,2003

Reference Books:

- G. Goodwin, S.Graebe, Mario Salgado, Control System Design –, Pearson Education, edition,
- G. Franklin,J.Powell,A. Naeini, Feedback Control of Dynamic Systems- Pearson, edition, Education
- K. Ogata, Modern Control Engineering- Prentice Hall Publications, fifth edition,

IE Digital Techniques

Teaching Scheme:
Lectures : 3 hrs/week

Examination Scheme:
Assignments/Quiz/T1/ T2-40
End Sem. Exam. – 60

Unit 1 **(6hrs)**

Digital 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 **(7hrs)**

Combinational Logic Design: Combinational circuits, analysis procedure, design procedure, Boolean algebra, K- map, 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 **(7 hrs)**

Sequential Logic Design: 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 **(7hrs)**

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 **(6hrs)**

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 **(7 hrs)**

Programmable Logic Devices II: Introduction to FPGA and its various architectures. PLD Programming concepts, Introduction to PLD Programming languages.

Text Books:

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

Reference Books:

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

Course Outcomes:

i. Describe various logic families [PEO1][PO-a]
ii. Apply Boolean algebra and other minimization techniques to digital circuits. [PEO1] [PO-a]
iii. Design combinational and sequential circuits for a given problem / case studies related to digital circuits. [PEO1] [PO-e]
iv. Evaluate appropriate hardware and software tools for combinational and sequential circuit design, implementation and verification. [PEO2] [PO-k]

IE Transducers II Laboratory

Teaching Scheme:
Practical :2hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam. - 50

List of Experiments:

1. Characterization and calibration of potentiometer as displacement sensor. Study of loading effect on potentiometer (linear and rotary).
2. Characterization and calibration of LVDT based displacement measurement system.
3. Characterization of strain gauge using cantilever beam.
4. Characterization and calibration of speed measurement system. (Photoelectric and magnetic Pick-up).
5 Characterization and calibration of vibration measurement system. (Piezo-resistive vibration pick-up).
6. Characterization and calibration of piezoelectric measurement system.
7. Proximity sensors (inductive), measurement and application.
8. Study of encoder as displacement sensor.
9. Study of the detectors(leak detectors, flame detectors, smoke detectors)
10. Case studies (minimum four) based on above sensors.

Course Outcomes:

i. Identify various elements required for characterization of given transducers/sensors. [PEO2][PO-e]
ii. Design and conduct experiments for measurement, characterization, and ability to analyze and interpret data. [PEO1] [PO-b]
iii. Communicate effectively in oral and written form while formulating experiments, reports and other related documents. [PEO3][PO-g]

IE AUTOMATIC CONTROL SYSTEM LABORATORY

Teaching Scheme:
Practical: 2-hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam. - 50

List of Experiments:

1. Study of multivariable control system.
2. Analysis of second order (R-L-C) system in time domain.
3. Study of type 0 and type 1 system
4. To find the transfer function of unknown system (electrical network)
5. Write a program to find Routh table and comment on its stability
6. Write a program to design controller using root locus technique
7. Write a program to draw bode plot of a given transfer function
8. Write a program to find step and ramp response of a second order system and verify with physical system
9. Write a program to draw Nyquist plot of a given transfer function
10. Develop a Simulink model to find steady state error for a type 0, type 1 and type 2 system.

Course Outcomes:

i. Stability analysis of Control System. [PEO1] [PO-b]

ii. Develop mathematical model for electrical systems. [PEO2] [PO-a]

iii. Analyze second order systems and validate using MATLAB. [PEO1] [PO-m]

IE Digital Techniques Laboratory

Teaching Scheme:
Practical : 2 hrs/week

Examination Scheme:
Continuous Assessment-50
Practical Exam. - 50

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.

Course Outcomes:

i. Design experimental setup for measurement of digital IC parameters & its verification. [PEO1] [PO-b]
ii. Design, realize and analyze various combinational and sequential circuits [PEO1] [PO-e]
iii. Select and use latest hardware and software tools for digital system realization. [PEO2][PO-k]

IE Numerical Methods Laboratory

Teaching Scheme:

Practical : 3 hrs/week

Tutorial: 1 hrs/week

Examination Scheme:

Continuous Assessment-50

Practical Exam. - 50

List of Experiments:

1. Roots of Non-Linear Equations-To find the roots of non-linear equations using Bisection method.
2. Roots of Non-Linear Equations -To find the roots of non-linear equations using Newton-Raphson method.
3. Interpolation- Using Linear or Quadratic interpolation, finds intermediate data points from given set of data.
4. Interpolation- Using Lagrange interpolation, find intermediate data point form given set 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 method
13. Differential Equation-To find numerical solution of ordinary differential equations by Runge- Kutta method.

Course Outcomes:

i. Be familiar with the use of numerical methods in modern scientific computing

ii. Be familiar with finite precision computation

iii. Be familiar with numerical solutions of nonlinear equations in a single variable

iv. Ability to determine different methods of numerical interpolation and approximation of functions

v.Be familiar with numerical integration and differentiation