Autonomous Programme
of
Second Year B.Tech.
Instrumentation and
Control Engineering

Autonomous Programme Structure of
Second Year B.Tech. Instrumentation and Control Engineering

S.Y B.Tech. Instrumentation and Control Semester-I											
Course Code	**Course Title**	**Teaching Scheme**			**Examination Scheme**					**Marks**	**Credit**
		Hours/Week									
		Lecture	Tutorial	Practical	CA	In sem	End sem	Oral	Practical		
IN2101	**Sensors and Transducers I**	3	1	0	10	40	50	0	0	100	4
IN2102	**Basic Instrumentation**	3	0	0	0	25	50	0	0	75	3
IN2103	**Linear Integrated Circuits**	3	1	0	10	40	50	0	0	100	4
IN2104	**Digital Techniques**	3	1	0	10	40	50	0	0	100	4
BSIN2101	**Engineering Mathematics-III**	3	1	0	10	40	50	0	0	100	4
IN2105	**Programming Practice**	0	0	2	25	0	0	0	0	25	1
IN2106	**Sensors and Transducers I lab**	0	0	2	0	0	0	0	25	25	1
IN2107	**Basic Instrumentation lab**	0	0	2	25	0	0	0	0	25	1
IN2108	**Linear Integrated Circuits lab**	0	0	2	0	0	0	0	25	25	1
IN2109	**Digital Techniques lab**	0	0	2	0	0	0	0	25	25	1
Total		**15**	**4**	**10**	**90**	**185**	**250**	**0**	**75**	**600**	**24**
Grand Total		**29**			**600**					**600**	**24**

AC 201 -- Audit Course: Art& Craft / Basic Photography / Contemporary Dance / Film Appreciation/English Communication

Autonomous Programme Structure of
Second Year B.Tech. Instrumentation and Control Engineering

S.Y B.Tech. Instrumentation and Control Semester-II												
Course Code	**Course Title**	**Teaching Scheme**			**Examination Scheme**					**Marks**	**Credit**
		Hours/Week									
		Lecture	Tutorial	Practical	CA	In sem	End sem	Oral	Practical		
IN2201	**Sensors and Transducers II**	3	1	0	10	40	50	0	0	100	4
IN2202	**Electronic Instrumentation & System Design**	3	1	0	10	40	50	0	0	100	4
IN2203	**Analytical Instrumentation**	3	0	0	0	25	50	0	0	75	3
IN2204	**Control Systems I**	3	1	0	10	40	50	0	0	100	4
HS2201	**Principles of Economics and Finance**	3	0	0	0	50	50	0	0	100	3
IN2205	**Sensors and Transducers II lab**	0	0	2	0	0	0	0	25	25	1
IN2206	**Electronic Instrumentation & System Design lab**	0	0	2	0	0	0	0	25	25	1
IN2208	**Analytical Instrumentation**	0	0	2	25	0	0	0	0	25	1
IN2209	***Lab Practice I**	0	0	2	25	0	0	0	0	25	1
AC2201	**Self Expression**	0	0	2	0	0	0	0	0	0	No Credits
Total		**15**	**3**	**10**	**80**	**195**	**250**	**0**	**50**	**575**	**22**
Grand Total		**28**			**575**					**575**	**22**

***Lab Practice I: Assignments/ Practicals based on Circuit Theory and Applied Biology should be conducted.**

S.Y B.Tech.
Instrumentation and Control
Semester-I

IN 2101 SENSORS AND TRANSDUCERS-1

Teaching Scheme
Lectures: 3 Hrs/week
Tutorial: 1 Hour/week

Examination Scheme
C.A: 10 marks
In semester: 40 Marks
End semester: 50 Marks
Credits: 3

Prerequisites:
1. Basics of physical parameter
2. Basic sensing material
3. Basic Instrumentation

Course Objectives:
1. To acquire the knowledge of basic principles of sensing various parameters
2. To study principles, working, mathematical relation characteristics, advantages and limitations of various sensors and transducers
3. To select appropriate transducer for the typical application

Course Outcomes:
1. Student learn application of different sensors
2. Learn how to design sensor for particular range
3. Can select different sensor for different physical parameter

Unit 1: Introduction (06)
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: Pressure Measurement (06)
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 3: Temperature Measurement (05)
Temperature scales, classification of temperature sensors, standards, working principle, types, materials, design criterion: Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistors), radiation sensors (pyrometers).Temperature switch

Unit 4: Level Measurement (06)
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 switch.

Unit 5: Flow Measurement **(06)**

Standards, working principle, types, materials, 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 switch.

Unit 6: Allied Sensors **(07)**

Standards, working principle, types, materials, design criterion: Chemical sensors (pH and conductivity), leak detector, flame detector, smoke detector, humidity, density, viscosity sensors, and, Sound sensors, introduction to advanced sensors(MEMS) ,Non-destructive Sensor

Text Books:

1. A.K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons,
   Eleventh ed., 2000.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis", Tata McGraw Hill Education, Second ed., 2004.
3. D.V.S. Murty, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
4. C. D. Johnson, 'Process Control Technology' PHI-Seventh Edition.
5. C.S. Rangan ,G..R.Sharma, V.S.V Mani , "Instrumentation Devices and Systems"

References:

1. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fourth ed., 1990.
2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
3. Sabrie Soloman, "Sensors Handbook", McGraw Hill Publication, First ed., 1998.
4. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Third ed., 1995.

List of Tutorials:

1. Understanding of internal mechanism of pressure gauge
2. Construction and performance testing of pressure switch
3. Construction and working of thermostat solid state
4. Principle and testing of pyrometer using light source and thermocouple
5. Testing of lead wire compensation of RTD
6. Study of float switch
7. Study of electromechanical level sensor
8. Study of turbine flow meter
9. Study of smoke detector
10. Characterization of thermistor

IN2102 BASIC INSTRUMENTATION

Teaching Scheme
Lectures: 3 Hrs/week

Examination Scheme
In semester: 50 Marks
End semester: 50 Marks
Credits: 3

Prerequisite: Basics of Electrical and Electronic Systems.

Course objectives:

5. To introduce the fundamentals of measurements and instrumentation.
6. To explain the working principle of DC & AC meters for voltage, current, energy, power.
7. To study different bridges used for measurement of electrical parameters such as R, L, C.
8. To learn the operation of Oscilloscope, Signal Generator, Digital instruments and Recorders.

Course outcomes:

1. Explain the fundamentals of measurements and instrumentation system.
2. Select proper instrument with appropriate characteristics for given application.
3. Calibrate and monitor a variety of electronic instruments.
4. Analyze and troubleshoot instrument problems.

UNIT 1: Introduction to Instrumentation System (06)
Instrumentation system block diagram, Static and Dynamic characteristics of instruments, loading effects, Errors, calibration of instruments, Standards NEMA, BIS, DIN and ANSI.

UNIT 2: Analog Indicating Instruments (06)
Working Principle, Construction Derivation, Applications of DC galvanometer, PMMC, Wattmeters, Energy meters, DC Potentiometers

UNIT 3: Bridge Circuits (06)
Network Theory Basics, Circuit Diagram, General equations for bridge balance Derivation, Phasor Diagram, Applications of DC & AC bridges.

UNIT 4: Oscilloscope (06)
Block Diagram, Front Panel Functioning, Measurement of electrical parameters like voltage, current, frequency, phase

UNIT 5: Digital Instruments (06)
Block diagram, principle of operation, Digital Multimeter, Specifications of DMM, Digital Panel Meter

UNIT 6: Recording Instruments (06)
Principle and working of strip chart and X-Y recorders. Basics of virtual instrumentation

Text Books:

1. Sahwaney A K, Electrical and Electronics Measurements and Instruments
2. Cooper, W.D. and Helfric, A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall of India, 1991.

References:

1. Kalsi.H.S., Electronic Instrumentation, Tata McGraw Hill, New Delhi, 1995.
2. David.A.Bell, Electronic Instrumentation and Measurements, Second Edition, Prentice
3. Hall, New Jersy, 1994.
4. R. Subburaj, 'The foundation for ISO 9000 and TQM',
5. Bouwens A. J., 'Digital Instrumentation'
6. Anand M. M. S., 'Electronic Instruments and Instrumentation Technology',PHI, 2004

IN2103- Linear Integrated Circuits

Teaching Scheme
Lecture: 3 Hrs./week
Tutorials: 1Horr/week

Examination Scheme
C.A : 10 marks
In semester: 40 marks
End semester: 50 marks
Credits: 4

Prerequisite:
1. Concepts in basic electrical and electronics engineering
2. Concept of Transistor theory and application

Course Objectives:
1. To illustrate the concepts of the basic characteristics, construction, open loop & close loop operations of Operational-Amplifier (Op-amp)
2. To enable students to analyse and design different linear and non-linear circuits using Op-amp, To introduce applications of various configurations of amplifiers.
3. To enable students to demonstrate Electronic Circuits for Multivibrator and Voltage regulator using special purpose ICs
4. To illustrate types of filter, their applications and enable students to implement active filter circuits.

Course Outcome:
1. Ability to illustrate AC and DC characteristics of operational amplifier and their significance in selection of Op-amp
2. Ability to apply different configurations of Op-amp
3. Ability to design and implement linear, non-linear Op-Amp circuits and different electronic circuits using specialized ICs
4. Ability to analyse and interpret the designed, implemented data.

Unit 1: Operational Amplifier Fundamentals (06)
Block diagram of Operational amplifier, Noise in Op-amp, types of Noise(definitions of Shot noise, Thermal noise, Flicker noise, Burst noise, Avalanche noise), Introduction to Open and Closed Loop configurations of Op-Amplifier, Characteristics of Operational amplifier, Causes of Slew rate, Measurement of Slew rate (SR), Common Mode Rejection Ratio (CMRR), Power Supply Rejection ratio (PSRR/SVRR), Frequency response, Offset nullification techniques, comparative study of different amplifiers (LM741,LM324,OP07)

Unit 2: Effect of Feedback in Op Amps (06)
Introduction to feedback amplifiers, Voltage series feedback (Non-inverting amplifier with feedback): deriving close loop gain, input impedance, output impedance and bandwidth; Voltage follower and its applications, Voltage shunt feedback (Inverting simplifier with feedback): deriving close loop gain, input impedance, output impedance and bandwidth; Inverter circuit, Differential amplifier with one op-amp: deriving close loop gain

Unit 3: Linear Applications of Op Amps (06)
Voltage summing with average, Voltage subtractor, Current booster, Integrator, and practical integrator, Differentiator and practical differentiator, Instrumentation amplifier with three Op-amps,

Current to Voltage converter, voltage to current converter (grounded and floating load), Isolation amplifiers, chopper stabilized amplifiers, Equation solving with Op-amp

Unit 4: Non Linear Applications of Op Amps (05)

Comparator and its characteristics, Study of IC-LM311, Zero Crossing Detector (ZCD) and its use, Schmitt trigger with external bias, window detector, Precision half wave and full wave rectifiers, Sine wave oscillators using op-amp.: Barkhausen criteria, Wein bridge and RC phase shift oscillator

Unit 5: Timers and Voltage Regulators (06)

Design and applications of Multi-vibrators: Astable, Monostable (Retriggerable and Non-retriggerable), Bi-stable using IC- LM555, Pulse generator using LM555

Voltage regulators: Performance parameters (line regulation, load regulation, ripple rejection), Fixed voltage regulators (IC78xx, 79xx), Linear voltage regulator IC 723 (High voltage, low voltage regulator circuits), Basics of switching regulator, Voltage and current waveforms, basics of step-down (Buck) switching regulator

Unit 6: Active Filters (06)

Butter-worth approximations, Low pass (LP), High pass (HP), Band pass(BP), Narrow band pass, Band reject, Notch filter, First and second order filters, (Design of LP, HP filter and BP filter), Difference between active and passive filters and their merits and demerits. Filter terminology: Pass band, Stop band, cut off, Ripple, Q and order of the filter

Text Books:

1. Ramakant Gaikwad, "Operational Amplifiers" PHI, 3 rd ed., 1992.
2. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th edition, Pearson Education India, 2002.
3. D. Roy Choudhury, "Linear Integrated Circuits" New Age International, 4th edition Electronic Instrumentation by Oliver Cage, McGraw Hill.

References:

1. Paul Horowitz, Winfield Hill , "The Art of Electronics", 2nd Ed., Cambridge University press,

List of Tutorials:

1. Practical method of measurement of input and output resistance of an op-amp
2. Significance of loading effect in amplifier
3. Designing and implementation of equation solving circuits.
4. Designing and implementation of Celsius to Fahrenheit converter circuit.
5. Concept of SPAN and ZERO in signal conditioning circuits.
6. Signal detection and conversion using op-amp.(V to I, current booster, I to V)
7. Designing and testing of speed pick-up using Zero Crossing Detector (ZCD).
8. Designing and testing of Automatic Street light control using LM555.
9. Designing and testing of different sirens using LM555.
10. Effects of filters on audio signals.

IN2104: Digital Techniques

Teaching Scheme:

Lectures: 3 Hrs/Week

Tutorial: 1 hour/week

Examination Scheme:

C.A: 10 Marks

In Semester: 40 Marks

End Semester: 50 Marks

Credits: 4

Prerequisite:

Basics of Transistor Theory and Basic Electronics.

Course Objectives:

1. To learn and understand basic digital design techniques.
2. To learn and understand design and construction of combinational and sequential circuits.
3. To lay the foundation for further studies in embedded systems, VLSI, micro-processor etc.

Course Outcomes:

1. To represent numerical values in various number systems and perform number conversions between different number systems.
2. Understand the basic logic gates and variable reduction techniques of digital logic circuit.
3. Analyze, design and develop combinational and sequential digital circuits.
4. Understand operation of basic types of flip-flops, registers, counters, decoders, encoders, multiplexers, and de-multiplexers.

Unit 1: Number System, Codes & Boolean Algebra (07)

Introduction: Binary, Octal, Decimal, Hexadecimal Numbers, Number Conversion and their arithmetic, Signed Binary number representation, 1's & 2's complement representation.
Codes: BCD, Excess-3, Gray Code, Error Detecting & Correcting Codes, Code Conversions.
Classical Reduction Technique-Boolean Algebra: DeMorgan's Rules, Basic Theorems and Properties of Boolean Algebra.

Unit 2: Logic Circuit Minimization Techniques & Logic Families (08)

Reduction Techniques: SOP/POS form, Cannonical SOP/POS form, Don't care Condition, Simplification by K-Maps up to 4 variables and Quine-McClusky Technique.
Logic Families: Standard Characteristics: Propagation Delay, Power Dissipation, Fan-In, Fan-Out, Current and Voltage Parameters, Noise Margin.
TTL & CMOS Family: Standard TTL Characteristics, Operation of TTL NAND gate-Totem Pole, Open Collector, Wired AND. CMOS Characteristics, CMOS Inverter, Tri State Logic, Comparison of TTL & CMOS.
Interfacing: Interfacing TTL to CMOS and CMOS to TTL.

Unit 3: Combinational Logic (05)

Circuits: Half-Adder, Full Adder, Half Subtractor, Full Subtractor, BCD Adder, Parity Generator and Checker, Magnitude Comparator.

Decoders & Encoders: Working of Decoder, Implementation of expression using decoders, IC 74138, BCD to 7 segment decoder circuits, decoder driver IC 7447. Working of Encoders, Priority Encoders.
Multiplexers (MUX): Working of MUX, Implementation of expression using MUX (IC 74151).
Demultiplexers (DEMUX): Working of DEMUX, Implementation of expression using DEMUX.

Unit 4: Sequential Logic **(07)**

Introduction to Sequential Circuits: Difference between Combinational Circuits and Sequential Circuits.
Flip-Flops: Internal Design, Truth Table, Excitation Table of SR, JK, D, T Flip Flops, Conversion of Flip Flop, Study of Flip Flop ICs – 7473, 7474, 7476.
Registers: Buffer Register, Shift Register, Universal Shift Register IC 7495.

Unit 5: Sequential Logic Design and Applications **(09)**

Counters: Definition of modulus of counter, Asynchronous Counters, Synchronous Counters, Ring and Johnson counters, Divide by N-counter, Timing Diagram of Counters, Realization of Counters using ICs 7490, 7492, 7493 and 74193 (Programmable Counter IC)
Sequence Generator/Pulse Train Generator: Using Shift Registers and Counters.

Unit 6: PLDs & Applications **(03)**

PLD: PLA- Input, Output, AND, OR, Invert/Non-Invert Matrix.
Design Example: 4 variables SOP function using PLDs, study of basic architecture of FPGA and CPLD.
Applications of Digital Circuits: Digital Clock and Alarm Annunciator.

List of Books:

1. R. Jain, *"Modern Digital Electronics"*, 3rd Edition, Tata McGraw-Hill.
2. Malvino and Leach, *"Digital Principals & Applications"*, 4th Edition, Tata McGraw-Hill.
3. Ronald J. Tocci, Neal S. Widmer and Gregory L. Moss, *"Digital Systems, Principals and Applications"*, 10th Edition, Pearson Education International.
4. Gothman, *"Digital Electronics"*, 2nd Edition, PHI.
5. Thomas Floyd *"Digital Principles"*, Pearson Education.
6. M. Morris Mano, *"Digital Design"*, Pearson Education Asia, 3rd Edition.

List of Tutorials: Conduct any eight tutorials

1. Problems based on number conversion and their arithmetic.
2. Problems based on Boolean Algebra reduction technique.
3. Problems based on 4/5 variable Quine-McClusky method.
4. Design Priority Encoder.
5. Design Manitude comparator and implement it in Proteus.
6. Study SISO, SIPO, PISO & PIPO mode of Universal Shift Register IC 7495 (on Digital Trainer Kit)
7. Design counters using ICs 7490, 7492 and 7493 in combination.
8. Design Pulse Train Generator using shift register and its implement in Proteus.
9. Batch wise power point presentation on 'Evolution of PLDs to FPGAs'.

10. Batch wise power point presentation on any one interesting application of flip-flops (application has to be out of syllabus)

BSIN201 ENGINEERING MATHEMATICS III

Teaching Scheme
Lecture : 3 Hrs/week
Tutorials: 1Hour/week

Examination Scheme
C.A: 10 marks
In semester : 40 marks
End semester : 50 marks
Credits : 4

Prerequisite:
Mathematical concepts studies in subjects M-I and M-II

Course Objectives:

1. To recall and remember basics of LDE, Vector analysis, Fourier and Z-transforms, LaplaceTransform.
2. To understand the concepts of basic mathematical methods for solving Higher order LDE, Vector analysis, Fourier and Z-transforms, Laplace Transform.
3. To apply these methods to solve Engineering problems.
4. To analyze Engineering problems and evaluate.

Course Outcomes:

1. Students will be able to remember terminologies and formulae in LDE, Vector analysis, Fourier and Z-transforms, Laplace transform.
2. Students will be able to understand and interpret the concepts of LDE, Vector analysis, Fourier and Z-transforms, Laplace transform.
3. Students will be able to predict and apply the methods for solving LDE, Vector analysis, Fourier and Z-transforms, Laplace Transform.
4. Students will be able to compare and analyze the methods for solving LDE, Vector analysis, Fourier and Z-transforms, Laplace Transform.

Unit 1: Vector Differentiation **(06)**
Higher order Linear differential Equation with constant coefficients, Cauchy's and Legendre'sDifferential Equations, Simultaneous Differential Equations, Modeling of electrical circuits.

Unit 2: Vector Integration **(06)**
Line integral, Surface integral , Volume integral, Work done, Green's Lemma, Stokes Theorem, Gauss' divergenceTheorem.

Unit 3: Higher Order Linear Differential equations and applications **(08)**
Higher order Linear differential Equation with constant coefficients, Cauchy's and Legendre's Differential Equations, Simultaneous Differential Equations, Modeling of electrical circuits.

Unit 4: Laplace Transform **(08)**
Definition of Laplace, Inverse Laplace transform, Properties and theorems, LT of standard functions, LT of some special functions viz. periodic, unit step, unit impulse, application of LT for solving Linear Differential Equations.

Unit 5: Fourier Transform. **(06)**

Complex exponential form of Fourier series, Fourier integral theorem, sine and cosine integrals,Fourier transform, Fourier Sine and Cosine transform , Inverse Fourier Transform.

Unit 6: Z- Transform **(06)**

Definition, standard properties, Z- Transform of standard sequences, Inverse Z – Transform using standard results, Inversion integral method, solution of difference equation.

Text Books:

1. B. V. Ramana, 'Higher Engineering Mathematics ',Tata McGraw Hill Publications(2007)
2. B.S. Grewal, 'Higher engineering Mathematics', Khanna publishers, Delhi (40 th edition), (2008)
3. Peter V. O'neil,'Advanced Engineering Mathematics' ,Thomson Brooks / Cole, Singapore (5th edition) (2007).

References:

1. C.R.Wylie, L.C. Barrette, 'Advanced Engineering Mathematics', McGraw Hill Publications, New Delhi.(6 th edition)(2003)
2. Erwin Kreyszig ,'Advanced Engineering Mathematics' Wiley Eastern Ltd.(8th Student Edition), (2004).

List of tutorials:

1. Examples on vector differentiation, gradient ,divergence and solenoidal field.
2. Examples on curl , irrotational field,directional derivatives &vector identities.
3. Examples on line integral, work done Green's lemma.
4. Examples on Stoke's theorem and Gauss divergence theorem.
5. Examples on shortcut methods for finding PI
6. Examples on genereal method and method of variation of parameters
7. Examples on finding solution of simultaneous DE, symmetric DE
8. Examples on Finding LT using standard functions and properties
9. Examples on special functions and using special functions.
10. Examples on inverse LT and applications.
11. Examples on finding FT and Fourier integral theorem.
12. Examples on Fourier sine transform and Fourier cosine transform and inverse FT
13. Examples on ZT of standard sequences and finding ZT using properties
14. Examples on inverse ZT

IN2105 Programming Practice

Teaching Scheme
Practicals: 2Hrs/week

Examination Scheme
Practicals : 25 marks
Credit : 1

List of Experiments:

1. Program in C for calculating factorial of entered number and printing the first 20 elements in the Fibonnaci series using functions.
2. Program in C for string reversal and swap and exchange of array data.
3. Program in C for a simple calculator with the basic 4 operations using switch case.
4. Program in C for any 2 Sorting methods using arrays.
5. Program in C for Linear and Binary Search methods using arrays.
6. Program in C for addition and multiplication of matrices using nested for loop.
7. Program in C to implementation Stack using arrays.
8. Program in C to implementation Queue using arrays.
9. Program in C for polynomial addition.
10. Program in C for database management using structures.
11. Program in C involving graphics commands in C.

IN 2106 SENSORS AND TRANSDUCERS-1 LAB

Teaching Scheme
Practicals: 2Hrs/week

Examination Scheme
Practicals : 25 marks
Credit : 1

List of Experiments:

1. Study the working of Dead weight pressure gauge tester and calibration of pressure gauge using it.
2. Study the working of Dead weight vacuum gauge tester and calibration of a vacuum gauge using it.
3. Plot the characteristics of RTD and calculate its time constant.
4. Plot the characteristics of Thermocouple and study cold junction compensation.
5. Design and Test Air purge probe for Level Measurement.
6. Flow measurement using Rotameter, orifice and Electromagnetic flowmeter.
7. Measurement of viscosity of various liquids using Red wood Viscometer.
8. Water level measurement using Piezoresistive MEMS sensor.
9. Non-destructive testing using ultrasound transducer
10. Measurement of Ph of given sample

IN2107 BASIC INSTRUMENTATION LAB

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
CA: 25 Marks
Credit: 1

List of Experiments:

1. Design and implementation of multi-range ammeter using PMMC Ammeter.
2. Conversion of given PMMC Ammeter into multi-range Voltmeter by implementing the designed circuit.
3. Design and implementation of series and shunt type ohmmeter using PMMC ammeter and compare the measured unknown resistance values with the color code.
4. Design of Wheastone's Bridge for measurement of unknown resistance and calculate the sensitivity for different P/Q ratios.
5. Calibration of D.C. potentiometer and measurement of unknown voltage using it.
6. Power measurement using Electrodynamometer type Wattmeter (Single phase) and testing its performance.
7. Power measurement using Induction type Energymeter (Single phase) for resistive load.
8. Measurement of Voltage, Frequency and Phase using CRO in Y-t and X-Y mode of the given signals.
9. Study construction and working of Y-t, X-Y recorders.
10. Demonstration of Lab-View Software.

IN2108: Linear Integrated Circuits Lab

Teaching Scheme
Practicals: 2Hrs/week

Examination Scheme
Practicals : 25 marks
Credit : 1

List of Experiments:

1. Band width measurement of inverting and no inverting amplifier.
2. Measurement of CMRR, Slew rate and output offset voltage.
3. Designing and implementation of Instrumentation amplifier using IC LM324.
4. Designing and implementation of Integrator.
5. Designing and implementation of Differentiator.
6. Designing and implementation of Wien bridge oscillator.
7. Designing and implementation of Comparator, Schmitt trigger and Zero Crossing Detector.
8. Designing and implementation of Astable and Monostable multivibrator using LM555.
9. Voltage regulators: linear variable regulator LM723.
10. Measurement of performance of 78xx regulator.
11. Butterworth filter design and realization of first/second order Band Pass Filter.

IN2109: Digital Techniques Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
Practical Exam: 25 Marks
Credits: 1

List of Experiments

1. Study of Gates and Implementation of Gates using NAND & NOR Logic.
2. Code Conversion: Binary to Gray, Gray to Binay and Excess-3 to BCD.
3. Study of Interfacing of TTL and CMOS ICs.
4. Design and Implementation of Adder and Subtractor using logic gates.
5. Study of Multiplexer IC74151. Implementation of Adder/Subtractor and SOP expression using MUX IC.
6. Interfacing of 7 segment LED display using IC 7447.
7. Study of Flip–Flop ICs and conversion of flip –flop from one other.
8. Design Ring & Johnson Counters using D-FF IC 7474 or Shift Register IC 7495.
9. Implementation of MOD-N Counters using 7490, 7492 & 7493 ICs.
10. Study of Preset table Up/Down Counter using IC 74193.
11. Design of Non Sequential Counter using flip –flop ICs.
12. Simulation of Digital Clock using Proteus Software by Labcenter.
13. Simulation of various digital circuits using Proteus Software by Labcenter.
14. Simulation of Alarm Annuncitaor using LabVIEW by National Instruments.

S.Y B.Tech.
Instrumentation and Control
Semester-II

IN 2201 SENSORS AND TRANSDUCERS-II

Teaching Scheme
Lecture : 3 Hrs/week
Tutorials: 1Hour/week

Examination Scheme
C.A: 10 marks
In semester : 40 marks
End semester : 50 marks
Credits : 4

Prerequisites:
1. Basics of physical parameter
2. Basic sensing material
3. Basic Instrumentation & OP-AMP
4. Sensors and Transducers -1

Course Objectives:
1. To study measurement of some physical parameters
2. To learn analog and digital signal conditioning schemes for sensors/transducers
3. To design and study instruments based on applications

Course Outcomes:
1. Selection of appropriate transducer for specific application
2. Ability to select analog or digital signal conditioning
3. Designing of signal conditioning schemes for measuring various parameters.

Unit 1: Displacement Measurement (06)
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), Angular measurement.

Unit 2: Velocity and speed Measurement (06)
Standards ,working,principle,types,material ,design criteria:
Moving magnet and moving coil, Electromagnetic tachometer, photoelectric tachometer, Toothed rotor variable reluctance tachometer, magnetic pick-ups, encoder, Photoelectric pick up, shaft speed measurement. Applications of velocity measurement sensor

Unit 3: Vibration and Acceleration (05)
Standards working principle, types, material, design criteria: Eddy Current type, piezoelectric type, Seismic transducer.
Accelerometer: Potentiometric type, LVDT type, Piezoelectric type. Application of Acceleration ion and vibration sensor

Unit 4: Force and Torque Measurement (06)
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

Unit 5: Principles of Analog and Digital Signal conditioning (06)
Introduction, signal level and bias changes, linearization, conversation faltering and impedance matching, concept of loading, divider circuits, bridge circuits, lead compensation, RC filters (low

pass, high pass), Readout/ meter. Converters, Readout/display

Unit 6: Design of Signal conditioning circuit (07)

Thermocouple, RTD, Thermistor, load cell, potentiometric sensors, capacitive level sensor, LVDT, Optical Sensors (LDR, photodiode, photo transistor, photo cell).

Text Books:

1. Rangan, Sarma, Mani, 'Instrumentation Devices and Systems' Tata McGraw-Hill, Second Edition.
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. A.K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Sons,
5. Eleventh ed., 20005 D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw- Hill-second edition 1999.
6. C. D. Johnson, 'Process Control Technology' PHI-Seventh Edition.
7. Art of electronic book for signal condoning by harwitz

References:

1. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard, 'Mechanical Measurements', International Student edition, Addison- Wesley- 5thEd.
2. D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw-Hill- 1986.
3. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Third ed., 1995.
4. E.O. Doebelin, 'Measurement Systems Application and Design', McGraw Hill, 4th Edition, 1990.

List of tutorials:

1. Construction and working of speedometer
2. Study of digital dial gauge & digital micrometer
3. Study of Anemometer
4. Study of 3 axis MEMS accelerometer
5. Spring balance as a overload alarm
6. Study of optical source detector
7. Measurement of temperature using LM35
8. Measurement of temperature using thermocouple

IN2202 Electronic Instrumentation and System Design

Teaching Scheme
Lecture : 3 Hrs/week
Tutorial: 1 Hour/week

Examination Scheme
C.A : 10 marks
In semester : 40 marks
End semester : 50 marks
Credits : 4

Prerequisite:
1. Concepts covered in Basic Instrumentation subject
2. Concepts covered in Linear Integrated Circuits subject

Course Objectives:
1. To provide an overview and understand the internal structure of various laboratory measuring Instruments and Signal Conversion techniques.
2. To teach the theory of different types ADCs and DACs.
3. To introduce the theory and applications of various special purpose ICs.
4. To teach the various grounding shielding techniques and ESD, EMI/EMC effects.
5. To introduce the concepy of reliability.
6. To understand concepts related to PCBs – their types, design considerations, soldering techniques.

Course Outcome:
1. Be able to analyze the operation of different types of measuring instruments like True-RMS Meter, DVM, RLC-Q meter, Distortion Factor Meter, Universal Counter and know the working of measuring instruments.
2. Be able to analyze the operation of different types of signal generating instruments like Arbitrary Waveform Generator.
3. Know the complete internal structure of ADCs and DACs. Perform the experiments, analysis on ADC and DAC ICs.
4. Ability to design and use special purpose ICs
5. Ability to design own PCBs and solder the circuits

Unit 1: ADCs and DACs (07)
Sampling Theorem, Sample and Hold Circuit, ADC types like Flash, Counter, SAR and Dual-Slope, ADC Specifications, ADC Numerical, DAC types like Weighted-Resistor and R-2R ladder, DAC Specifications, DAC Numerical, Study of CD4051 and ICM7107

Unit 2: Measuring Instruments (05)
RMS concept and True RMS Meter, DVM and Automation in DVM – auto ranging, auto zeroing and auto polarity, Digital LCR-Q Meter, Concept of frequency measurement and Universal Counter and Its Mode like Frequency, Totalizing, Period, Time Interval, Ratio, Measurement Errors in counter.

Unit 3: Generators and Signal Analyzers (05)
Types of Frequency synthesis, Direct Digital Synthesis, Arbitrary Waveform Generator, Study of IC8038
Signal Analyzers - Distortion Analyzer, Spectrum Analyzers, FFT Analyzer

Unit 4: Guidelines for enclosure, components and accessories (05)
Grounding and shielding techniques, EMI and EMC, Source of EMI, Protection against EMI, EMI and EMC effects minimization methods, ESD, Protection against ESD

Unit 5: Special Application ICs (08)
Instrumentation amplifier AD620, Linear opto isolator IL300, V to I converters XTR110, Signal conditioners AD594/595, Phase Locked Loop CD4046, Programmable counter ICM7217, Optoisolator MCT2E, Power drivers ULN2803

Unit 6: PCBs and Reliability (06)
Printed circuit board - Design rules for analog and digital circuit PCB's, Single, Double, Multi layer and SMD boards, Soldering materials and techniques, need of flux and its characteristics
Reliability - Definition, Distinction between Quality and Reliability, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve

Text Books:

1. Modern Electronic Instrumentation and Measurement Techniques by Helfrick and Cooper, PHI
2. Digital Instrumentation by A. J. Bowen
3. Electronic Instrumentation Handbook by Coombs.
4. Electronic Instrumentation by Oliver Cage, McGraw Hill.
5. Electronic Instruments and Instrumentation Technology by Anand M. M. S., PHI
6. Electrostatic Discharge and Electronic Equipment, Warren Boxleitner IEEE press.
7. Printed Circuit Boards, Walter C. Bosshart, CEDT series, TMH.
8. Reliability Engineering,.E. Baiguruswamy.
9. Data manual for analog and digital lCs

References:

1. Electrical and Electronic Measurements and Instrumentation by David A. Bell, Prentice Hall of India.
2. Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co.
3. Electronic Instrumentation by J. J. Carr.
4. Electronic Instrumentation by H. S. Kalsi, McGraw Hill.
5. Noise Reduction Techniques, Ott.

List of tutorials:

1. Study of IC0809 in detail – pin details, internal schematic, working
2. Study of IC0808 in detail – pin details, internal schematic, working
3. Study of RMS meter – internal schematic, features
4. Study of Universal Counter - internal schematic, various modes
5. Study of IC8038 in detail – pin details, internal schematic, working
6. Study of Distortion meter – internal schematic, features
7. Study of MCT2E and ULN2803 – application for driving different types of loads
8. Study of IL300 – typical application circuit
9. Study of CD4046 as frequency multiplier
10. Study of XTR110 as 0A to 10A output voltage to current converter

IN2203 Analytical Instrumentation

Teaching Scheme
Lecture : 3 Hrs/week

Examination Scheme
In semester : 25 marks
End semester : 50 marks
Credits : 3

Prerequisite:
Basics of Optics and sensors

Course Objectives:
9. To learn law of photometry
10. To learn and understand instrumentation for all types of spectroscopy
11. To learn seperation methods such as chromatography and mass spectroscopy
12. To learn analysers

Course Outcome:
2. To understand working of Different analyzers
3. To understand working of all types of spectrometers which is based on law of photometry

Unit 1: Overview and Introduction **(06)**
Introduction to Analytical methods and its classification, electromagnetic spectrum
Basics of spectroscopy: Laws of Photometry, components of optical systems (sourse, wavelength selector, detectors, signal processor, readout device), single beam and double beam Instrument

Unit 2: Molecular Spectroscopy **(08)**
Electronic transition: UV-Visible spectroscopy, Fluorimeters and Phosphorimeters
Nuclear transition: Nuclear Magnetic Resonance (NMR) spectometry
Vibratinal transition: IR spectroscopy

Unit 3: Atomic Spectroscopy **(06)**
Atomic absorption spectroscopy: Principle, Hollow cathode source, Types, working, Background correction methods
Atomic emission spectroscopy: Principle, Sources (AC & DC Arc Excitation, Plasma Excitation), Types, working and Flame photometer

Unit 4: Separative Methods **(06)**
Components of mass spectrometry, Mass analyser types, Quantitative analysis of mixtures
Chromatography: Fundamental of chromatographic seperation, Gas chromatography, High Performance Liquid Chromatography

Unit 5: Gas analyzers **(05)**
Oxygen analyzer, carbon dioxide analyzer, Hydrocarbon Analyzers

Unit 6: Radio chemical Instrumentation **(05)**
X-ray spectrometry: X-ray Diffractometer, Bragg's law, Instrumentation for X-ray spectrometry
Radiation detectors: Ionisation chamber, Geiger-Muller counter, proportional counter, scintillation counters

Text Books:
1. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, CBS Publishers. & Distributors, New Delhi, 7th ed.
2. Skoog, Holler, Nieman, Thomson Principles of Instrumental Analysis, Books-cole Publications, 5th ed.

References:

1. Khandpur R. S., Handbook of Analytical Instruments, Tata McGraw–Hill Publications, 3rd ed.
2. Ewing Galen W., Instrumental Methods of Chemical Analysis, McGraw-Hill Book Company, 5th ed.
3. Braun Robert D., Introduction to Instrumental Analysis, McGraw-Hill Book Company.
4. Sherman R.E., Analytical Instrumentation, ISA Publication

IN2204 Control Systems-I

Teaching Scheme
Lecture : 3 Hrs/week
Tutorials: 1Hour/week

Examination Scheme
C.A : 10 marks
In semester : 40 marks
End semester : 50 marks
Credits : 4

Prerequisite:

Basics of Laplace transform, Linear algebra and complex number

Course Objectives:

1. Understand the basic components of control system, types of control systems.
2. Learn the developing relationship between system input and output.
3. To learn to develop system's mathematical models.
4. To understand the basic mathematical tools for analysis of the control systems.

Course Outcome:

1. Classify the control systems.
2. Develop mathematical models of control systems.
3. Analyze the system in time and frequency domain.
4. Get familiar with modern control systems.

Unit 1: Introduction to Control Systems (06)
Introduction, brief classification of control systems: Representation of: Electrical, mechanical, electromechanical, thermal, pneumatic, hydraulic systems, with differential equations, Concept of transfer function and state space representation. Advantages of state space representation over classical representation, Terminology of state space (state, state variables, state equations, state space).

Unit 2: Transfer function, block diagram algebra and signal flow graph (07)
Representation of transfer function of electrical, mechanical with force to voltage and force to current analogies, Block diagram algebra, Signal flow graph.

Unit 3: Time domain analysis of control systems (07)
Standard test signals, dynamic error constants. First order, second order systems and their response, Time domain specifications of first order and second order control systems, static error constants (kp, kv, ka, ess).

Unit 4: Stability Analysis (06)
Concept of Stability in *s* domain, Classification of Stability (BIBO stability and asymptotic stability), stability analysis by Hurwitz criterion and Routh array, concept of relative stability and its analysis using Routh array.

Unit 5: Root locus (06)
Definition, Evan's conditions for magnitude and angle, construction rules, determination of system gain at any point on root locus (from magnitude condition and by graphical method), Root locus of systems with dead time: Concept, approximation of dead time and construction rules.

Unit 6: Frequency Domain Analysis and Introduction to state space representation (07)
Bode plot, with and without dead time, determination of transfer function from asymptotic Bode plot, Polar plot, Nyquist plot

Representation of state models: direct (companion I and II *i.e.* controllable canonical and observable canonical forms), parallel and cascade decomposition.

Text Books:

1. I. J. Nagrath, M. Gopal, "Control System Engineering", 6th Edition, New Age International Publishers.
2. B. S. Manke, "Linear Control Systems", Khanna Publishers, New Delhi.
3. A. K. Jairath, "Problems and Solutions of Control Systems", CBS Publishes, New Delhi.

References:

1. K. Ogata, "Modern Control Engineering", PHI, New Delhi.
2. Norman S. Nise, "Control System Engineering", John Wiley and Sons.
3. B. C. Kuo, "Automatic Control Systems", PHI, New Delhi

Tutorial List

1. Introduction to computional software (MATLAB).
2. Introduction to Basic Matlab commands and functions.
3. Introduction to Conrol system toolbox.
4. Study of standard test signals.
5. Analysis of time domain specifications using MATLAB.
6. Analysis of stability using root locus apporach
7. Analysis of stability in frequency domain (Bode plot)
8. Analysis of stability in frequency domain (Nyquist plot)
9. Conversion of SS to TF and TF to SS.

IN2205 Sensors and Transducer II Lab

Teaching Scheme
Practicals: 2Hrs/week

Examination Scheme
Practicals : 25 marks
Credit : 1

List of Experiments:

1. Design and implementation of signal conditioning for RTD
2. Measurement of Displacement using L.V.D.T. and testing of its performance characteristics.
3. Measurement of Displacement using Linear and Rotary Encoders and compare their resolutions.
4. Measurement of unknown weight using load cell and computing its hysteresis.
5. Design and implementation of weighing machine using load cell.
6. Design and implementation of liquid level indicator using electromechanical system
7. Design and implementation of liquid level indicator using capacitive transducer.
8. Design and implementation of through beam / reflected beam type optical proximity switch.
9. Angular speed measurement using optical Encoder and plot its characteristics.
10. Motor Speed measurement using contact and non-contact type tachometers and calculate error.
11. To measure vibration of a platform using piezoelectric type Vibrometer and calculate maximum amplitude of vibration.
12. Measurement of acceleration using Piezoelectric accelerometer and study its response.

IN2206 Electronic Instrumentation and System Design Lab

Teaching Scheme
Practicals: 2Hrs/week

Examination Scheme
Practicals : 25 marks
Credit : 1

List of Experiments:

1. Study and implementation of ADC IC 0809 along with IC4051
2. Study and implementation of DAC IC 0808
3. Study of RMS meter
4. Study and verify different modes of Universal Counter
5. Study and implementation of IC8038
6. Study of Distortion Meter
7. Study of optoisolator MCT2E and ULN2803
8. Study of optocoupler IL300
9. Study of PLL CD4046
10. Study of XTR110

IN2207 Analytical Instrumentation Lab

Teaching Scheme
Practicals: 2Hrs/week

Examination Scheme
Orals : 25 marks
Credit : 1

List of Experiments:

1. Analysis by using Photoelectric colourimeter
2. Analysis by using Densitometer
3. Study of Singal beam spectrometer
4. Analysis by using Double beam spectrometer
5. Analysis by using Flame photometer
6. Analysis by using Spectrofluorometer
7. Study of NMR Spectroscopy
8. Study of Atomic Absorption spectroscopy
9. Study of Gas Chromatography
10. Study of High Performance Liquid Chromatography

IN2208 Lab practice I

Teaching Scheme:
Practicals: 2 Hrs/Week

Examination Scheme:
CA: 25 marks
Credits: 1

List of Experiments:

1. Circuit solving using Kirchhoff's law
2. Network Analysis using Mesh current and Node voltage Method
3. Network Analysis using Superposition Theorem
4. Network analysis using Thevenin Theorem.
5. Study of Homeostasis for Blood sugar level, Temperature and Water level.
6. Anatomy of heart and its functioning- Explain concept of heart rate, arrhythmia, tachycardia and bradycardia.
7. Measurement of blood pressure using Sphygmomanometer.
8. Study the characteristics and applications of SCR and UJT
9. Speed and direction control of DC motor
10. Speed and direction control of stepper motor.
11. Application of ICM7217
12. Application of MM7107