Autonomous Programme Structure (Modified) of
Second Year B.Tech. Instrumentation and Control Engineering
Academic Year : 2019-2020

S.Y B.Tech. Instrumentation and Control Semester-I											
Course Code	Course Title	Teaching Scheme Hours / Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
IN2101	Sensors and Transducers I	3	1	0	50	50	0	0	100	4
IN2102	Basic Instrumentation	3	0	0	50	50	0	0	100	3
IN2103	Linear Integrated Circuits	3	1	0	50	50	0	0	100	4
IN2104	Digital Techniques	3	1	0	50	50	0	0	100	4
BSIN2101	Engineering Mathematics-III	3	1	0	50	50	0	0	100	4
IN2105	Programming Practice	0	0	2	25	0	0	0	25	1
IN2106	Sensors and Transducers I lab	0	0	2	0	0	0	25	25	1
IN2107	Basic Instrumentation lab	0	0	2	25	0	0	0	25	1
IN2108	Linear Integrated Circuits lab	0	0	2	0	0	0	25	25	1
IN2109	Digital Techniques lab	0	0	2	0	0	0	25	25	1
	Total	15	4	10	300	250	0	75	625	24
	Grand Total	29			625				625	24

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IN 2101: Sensors and Transducers I

Teaching Scheme
Lectures: 3 Hr/week
Tutorial: 1 Hr/week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

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: The student will be able to
1. define and list performance characteristic of different sensors and transducers.
2. compare features of different sensors and transducers.
3. select sensors and transducers for particular application.
4. analyze the performance of sensors and transducers for various applications.

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"
6. HKP Neubert .'Instrument Transducers'

Reference Books:

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

IN 2102: Basic Instrumentation

Teaching Scheme
Lectures: 3 Hr/week

Examination Scheme
In-Semester: 50 Marks
End-Semester: 50 Marks
Credit: 3

Prerequisite: Basics of Electrical and Electronic Systems.

Course Objectives:
1. To introduce the fundamentals of measurements and instrumentation.
2. To explain the working principle of DC & AC meters for voltage, current, energy, power.
3. To study different bridges used for measurement of electrical parameters such as R, L, C.
4. To learn the operation of Oscilloscope, Signal Generator, Digital instruments and Recorders.

Course Outcomes: The student will be able to
1. define different characteristics of 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, Watt meters, 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 Multi meter, 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.

Reference Books:
1. Kalsi.H.S., Electronic Instrumentation, Tata McGraw Hill, New Delhi, 1995.
2. David.A.Bell, Electronic Instrumentation and Measurements, Second Edition, Prentice

Hall, New Jersy, 1994.
3. R. Subburaj, 'The foundation for ISO 9000 and TQM',
4. Bouwens A. J., 'Digital Instrumentation'
5. Anand M. M. S., 'Electronic Instruments and Instrumentation Technology',PHI, 2004

IN 2103: Linear Integrated Circuits

Teaching Scheme
Lecture: 3 Hr/week
Tutorials: 1 Hr/week

Examination Scheme
In Semester: 50 marks
End Semester: 50 marks
Credit: 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 and 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 Outcomes: The student will be able to
1. define different characteristics of operational amplifier (op-amp).
2. select proper configuration of op-amp for given application.
3. develop op-amp based special purpose integrated circuits.
4. implement and test the performance of designed circuits.

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 (Retrigger able and Non- retrigger able), Bi-stable using IC- LM555, Pulse generator using LM555

Voltage regulators: Performance parameters (line regulation, load regulation, ripple rejection), Fixed voltage regulators (IC78xx, 79xx), Working Principle of 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 4. Instrumentation by Oliver Cage, McGraw Hill.

Reference Book:

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.

IN 2104: Digital Techniques

Teaching Scheme
Lectures: 3 Hr/Week
Tutorial: 1 Hr/week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 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: The student will be able to
1. Represent numerical values in various number systems and perform number conversions between different number systems.
2. List the basic logic gates and apply various reduction techniques to digital logic circuit.
3. Analyze, design and develop combinational and sequential digital circuits.
4. Design counters, multiplexers, demultiplexers and implementation of digital circuits using various building blocks.

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, Canonical 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.

Text 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 Magnitude 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)

BSIN 2101: Engineering Mathematics-III

Teaching Scheme
Lectures: 3 Hr/Week
Tutorial: 1 Hr/Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

Prerequisite:
1. Basics of integral and multiple integral.
2. Beta function, Gamma function.
3. Partial fractions.
4. First order linear differential equation.
5. Basics of vector algebra, basics of solid Geometry

Course Objectives:
Mathematics is a necessary path to scientific knowledge which opens new perspective of mental activity. Our aim is to provide sound knowledge of engineering mathematics to make the students think mathematically and strengthen their thinking power to analyse and solve engineering problems in their respective areas.

Course Outcomes: The student will be able to
1. formulate higher order Linear Differential Equations and apply to solve engineering applications.
2. obtain Fourier and Laplace Transforms of various functions and apply it to solve integral equations and differential equations.
3. obtain Z transforms and inverse Z transforms for various sequences and apply it to solve difference equations. Relate Z and Laplace Transforms.
4. interpret and evaluate results in Vector Calculus and apply it to obtain work done, surface integrals.
5. analyse and apply concepts of basic probability and probability distributions.

Unit 1: Higher Order Linear Differential equation and application **(08)**
Higher order linear differential Equation with constant coefficients, complementary function, particular integral, general method, short cut methods, Method of variation of parameter. Cauchy's and Legendre's D.E., Modelling of electrical circuits.

Unit 2: Fourier Transform **(06)**
Fourier integral theorem, , Fourier transform, Fourier Sine transform, Fourier Cosine transform, Inverse Fourier Transform.

Unit 3: Laplace Transform **(08)**
Definition of Laplace, Inverse Laplace transforms, 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, electrical circuits.

Unit 4: Z- Transform **(06)**
Definition, standard properties, Z- Transform of standard sequences, Inverse Z – Transform using standard results, Inversion integral method, solution of difference equation, introduction to relation between Z-transform and Laplace transform.

Unit 5: Vector Calculus **(08)**
Physical interpretation of vector differentiation, vector differential operator, Gradient, Divergence,

Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, vector identities, Line integral, surface integral.

Unit 6: Probability and Probability Distribution **(06)**

Theorems on probability, Random Variables – Discrete & continuous, Mathematical expectations, Probability density functions, Standard Distributions – Binomial, Poisson, Normal, Chi-square distribution

Text Books:

1. B. V. Ramana, 'Higher Engineering Mathematics', *Tata McGraw Hill Publications,* (2007).
2. B.S. Grewal, 'Higher Engineering Mathematics', *Khanna publishers, Delhi(*40th edition), (2008)
3. S.C. Gupta, V. K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10threvised edition), (2002).

Reference books:

1. C.R.Wylie, L.C. Barrette, 'Advanced Engineering Mathematics', McGraw Hill Publications, New Delhi (6th edition), (2003).
2. Erwin Kreyszig, 'Advanced Engineering Mathematics',*Wiley Eastern Ltd.*(8th Student Edition), (2004).
3. Peter V. O'neil, 'Advanced Engineering Mathematics', *Thomson Brooks / Cole, Singapore* (5th edition), (2007).

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 general 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

IN 2105: Programming Practice

Teaching Scheme
Practical: 2 Hr/week

Examination Scheme
In Semester: 25 Marks
Credit: 1

Course Outcomes: The student will be able to
1. list and identify the steps for the given problem statement.
2. apply different programming tools for logic development.
3. implement the devloped logic in the given programming language.
4. develop and design appropriate programs for practical applications.

List of Experiments:
1. Factorial of entered number and printing the first 20 elements in the Fibonacci series using functions.
2. Sring reversal and swap and exchange of array data.
3. Simple calculator with the basic 4 operations using switch case.
4. Any 2 Sorting methods using arrays.
5. Linear and Binary Search methods using arrays.
6. Addition and multiplication of matrices using nested for loop.
7. Stack using arrays.
8. Queue using arrays.
9. Operation on Polynomials.
10. Database management .

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IN 2106: Sensors and Transducers I Lab

Teaching Scheme
Practical: 2 Hr/week

Examination Scheme
In Semester: 25 marks
Credit: 1

Course Outcomes: The student will be able to
1. select instruments required for characterization of given sensors.
2. setup an experiment to compute characteristics of sensors and transducers.
3. plot and verify the characteristics.
4. analyze and inter operate the performance characteristic of sensors and transducers.

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 flow meter.
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

IN 2107: Basic Instrumentation Lab

Teaching Scheme
Practical: 2 Hr/week

Examination Scheme
In Semester: 25 Marks
Credit: 1

Course outcomes: The student will be able to
1. select proper measuring instrument with proper specifications for measurement.
2. calibrate the instruments for minimizing errors in the measurement.
3. troubleshooting of instrument for measurement purpose.
4. design different measurement meters based on the given range and parameter.

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 Energy-meter (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
Practical: 2 Hr/week

Examination Scheme
Practical: 25 marks
Credit: 1

Course Outcomes: The student will be able to
1. find and compare the performance characteristics of different OP AMP.
2. design and implement linear circuits using OP AMP.
3. design and implement non-linear circuits using OP AMP.
4. design and test signal conditioning circuits for industrial application.

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 Hr/Week

Examination Scheme
Practical: 25 Marks
Credit: 1

Course Outcomes: Students will be able to,
1. Apply different minimization techniques for nymber system conversions.
2. Select and use hardware and software tools for digital system realization.
3. Analysze various interfacing techniques for TTL and CMOS.
4. Design and implement various combinational and sequential digital circuits.

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.

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