Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Electronics and Telecommunication Engineering **Semester-III**

A) Course Code : 2028371(028)

B) Course Title : Network Analysis

C) Pre- requisite Course Code and Title : Elements of Electrical Engg.

D) Rationale :

Analysis and measurement of various parameters of electric circuit is the one of the primary works of diploma pass out. Voltage and current of any electrical and electronics circuits are required to check at various points in the circuit to maintain the working of that circuit. Network analysis course is indented to develop skills to calculating and measuring voltages and currents at various points of the given circuits. In this way students can develop the skills to test and maintain various electronics instruments/gadgets used in the domestic appliances and Industrial setups.

E) Course Outcomes:

CO-1 Analyze electrical circuit using basic law.

CO-2 Apply basic circuit theorems to simplify complicated circuits.

CO-3 Analyze series and parallel resonance condition in the given circuit.

CO-4 Analyze the circuit using two port network theorems.

CO-5 Analyze basic switching conditions and transient response.

F) Scheme of Studies:

S. No	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit (L+T+P/2)
1	E&TC Engineering	2028371(028)	Network Analysis	2	-	1	3
2	E&TC Engineering	2028361(028)	Network Analysis (Lab)	-	2	-	1

Legend: L-Lecture, P- Practical, T- Tutorial

G) Scheme of Assessment:

S. No	Board of Study	Course code	Course Title	Schemes of Examination					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1	E&TC Engineering	2028371(028)	Network Analysis	70	20	30	-	-	120
2	E&TC Engineering	2028361(028)	Network Analysis (Lab)	-	-	-	30	50	80

Legend: ESE- End semester Exam, CT- Class test, TA- Teacher Assessment

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Analyze electrical circuit using basic law.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Apply Ohm's law and Kirchhoff's law to calculate voltage and current in the given circuit. SO1.2 Apply source transformation and voltage division and current division techniques to measure various parameters of the given circuits. SO1.3 Analyse the given resistive circuits to calculate voltage and current using Mesh and nodal analysis method. SO1.4 Use star delta transformation technique to simplify circuit.	LE1.1 Measure voltage and current at various points in the given circuit and verify it by Kirchhoff's law. LE1.2 Measure voltage and current at various point in the given circuit and verify it by voltage division and current division.	**Unit-1.0Basic Concepts of Networks** 1. Ohms law 2. Kirchhoff's current and voltage law 3. Sources: Controlled and Independent sources, source transformation: voltage to current and current to voltage 4. Voltage division and current division techniques 5. Star-Delta transformation 6. Nodal Analysis, Super Node, Mesh Analysis, Super Mesh	• Identify the active circuit, passive circuit, linear circuit bilateral circuit • Star–delta transformation for circuit simplification

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Find an equivalent voltage source for two series connected voltage source 'V_1'
ii. and 'V_2' having internal resistance 'R_1' and 'R_2'.
iii. Find an equivalent current source for two parallel connected current sources 'I'_1 and 'I'_2 having internal resistance 'R'_1 and 'R'_2.
iv. Prepare a list of active and passive components and give the reason that, why it is called active or passive component.

b. Mini Project:

i. Develop a voltage divider circuit using resistors.

ii. Built a circuit to demonstrate the use of Maximum power transfer theorem.

c. Other Activities (Specify):

i. List various type of voltage source available in your institution and home.

CO-2 Apply basic circuit theorems to simplify complicated circuits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Apply the superposition theorem to calculate voltages and currents of the given multi source circuit. SO2.2 Calculate load voltage and current using Thevenin's and Norton's theorem. SO2.3 Calculate the internal resistance of the given circuit, to deliver maximum power to the load. SO2.4 Apply the given network theorem to simplify the given circuit.	LE2.1 Apply Superposition theorem to determine output voltage and current of the given multisource circuit. LE2.2 Apply the Thevenin theorem to determine output voltage and current of the given circuit. LE2.3 Apply the Norton's theorem to determine output voltage and current of the given circuit. LE2.4 Apply the maximum power transfer theorem to determine maximum power transferred to the load.	**Unit- 2.0 Network Theorems** 2.1 Linearity and Superposition theorem 2.2 Thevenin's and Norton's theorem 2.3 Milliman and Dual of Milliman theorem 2.4 Reciprocal and Maximum Power transfer theorem	• Differentiate between Thevenin's and Norton's theorem • Calculate the value of unknown resistance when the circuit deliver maximum power to the load.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Calculate the voltage and current for the given circuit using Thevenin's theorem and verify it by Norton's theorem.

ii. Show the Application of Thevenin's theorem in Maximum power transfer theorem.

iii. Determine the current and voltage of the various electrical circuits using different theorem.

iv. Explain why superposition theorem is not used for power calculation with suitable example.

b. Mini Project:

i. Demonstrate the superposition theorem for resistive network containing 3 sources.

c. Other Activities (Specify):

i. Seminar on various network theorems

CO-3 Analyze series and parallel resonance condition in the given circuit.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Calculate the resonance frequency, Quality factor and Bandwidth of the given series circuits. SO3.2 Calculate the resonance frequency, Quality factor and Bandwidth of the given parallel circuits. SO3.3 Describe the characteristic parameter of the given filter circuit. SO3.4 Analyze the frequency response of the following filters: LPF, HPF, BPF, BSF, Notch filter	LE3.1 For the given series resonance circuit, determine the frequency response curve to obtain the resonant frequency, resonant impedance, Bandwidth (BW) and Quality factor for series resonance circuit. LE3.2 For a parallel resonance circuit, determine the frequency response curve to obtain the resonant frequency, resonant impedance. LE3.3 Locate half power frequency on the characteristic curve of the following: LPF, HPF, BPF.	**Unit 3:Resonance and Filters Circuits** 3.1 Series Resonance: circuit diagram, resonant frequency, resonant impedance, Quality factor, Bandwidth, selectivity of series resonance circuit 3.2 Parallel Resonance: circuit diagram, resonant frequency, resonant impedance, Quality factor, Bandwidth, selectivity of parallel resonance circuit 3.3 Basics of filter: cutoff frequency, bandwidth, pass band, stop band, pass band attenuation, stop band attenuation, types of filter: LPF, HPF, BPF, BSF, Notch filter	• Describe application of series and parallel resonance circuit

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. Explain the application of RLC circuit in the oscillator
ii. Obtain bandwidth and Quality factor of the given parallel and series RLC circuit.
iii. State application of various types of filter.

b. Mini Project:

i. Demonstrate the deviation between theoretical values of resonance frequency of a series RLC with its practical value in the lab.
ii. Realize LPF and HPF for the given cutoff frequency.

c. Other Activities (Specify):

i. List various types of filters which used in various domestic and industrial application.

CO-4 Analyze the circuit using two port network theorems.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Describe the steps to calculate Z - parameter, Y-parameter, Transmission parameter, Hybrid parameter. SO4.2 Explain condition For Reciprocity and Symmetry for two port networks. SO4.3 Explain Interconnection of Two-port Network, Series connection, Parallel connection, Cascade connection. (For resistive, RL and RC circuits only).	LE4.1 Determine the Y and Z parameter of the given two port network. LE4.2 Determine the transmission and hybrid parameter of a two-port network. LE4.3 Measure voltages and currents for the given circuit to calculate equivalent parameter of series/parallel connection of two port network.	**Unit-4 Two Port Network** 1. Z-Parameter 2. Y-parameter 3. Transmission parameter 4. Hybrid parameter 5. Condition for Reciprocity and Symmetry for two port networks 6. Interconnection of Two-port Network: Series connection, Parallel connection, Cascade connection. (For resistive, RL and RC circuits only)	• Determine the circuit parameter for the given two port network

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Convert the Z parameter into Y parameter for the given two port network
ii. Establish relation between Y parameter and h-parameter, transmission parameter.
iii. Compute equivalent hybrid parameter of two different two port network connected in cascaded.

b. Mini project

i. Verify resultant Z-parameter of two series connected two port networks.
ii. Verify resultant Y-parameter of two parallel connected two port networks.

CO-5 Analyze basic switching conditions and transient response.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Determine response across of L and C element at initial and final condition for the given circuit. SO5.2 Analyze transient and steady state response of RLand RC circuit. SO5.3 Apply Laplace transformation technique to analyze transient and steady state response of the given circuit.	LE5.1 Determine the transient and steady state response series RC circuit. LE5.2 Determine the transient and steady state response for series RL circuit and also find out the time constant of the given circuit.	**Unit-5.0 Transient and Steady State Analysis** 5.1 Transient and steady state analysis 5.2 Behavior of L and C element at initial and final condition 5.3 Procedures to evaluate initial conditions, Transient and steady state analysis of RLand RC circuit 5.4 Application of Laplace Transformation Technique in Electric Circuit Analysis	• Problem solving on Laplace transformation to analyze the circuit. • Determine the transient response of the RLC circuit.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. Derive an expression for current in RC circuit and plot the curve between current and time.
ii. Derive an expression for current in RL circuit and plot the curve between voltage and time
iii. State the significance of time constant of RL and RC circuit.

I. **Mini Project:**

i. Build a RL circuit on bread board and observe the transient in current on CRO and prepare report on it.
ii. Build a RC circuit on bread board and observe the transient in current on CRO and prepare report on it.

c. Other Activities:

i. Power point presentation on the initial and final value of current and voltage of inductor and capacitor

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Basic Concepts of Networks	4	4	6	14
II	Network Theorems	3	5	6	14
III	Resonance and Filters Circuits	4	5	5	14
IV	Two Port Network	3	5	6	14
V	Transient and Steady State Analysis	2	6	6	14
	Total	**16**	**25**	**29**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Measure voltage and current at various points in the given circuit and verify it by Kirchhoff's law	15	10	5
LE1.2	Measure voltage and current at various point in the given circuit and verify it by voltage division and current division.	15	10	5
LE2.1	Apply Superposition theorem to determine output voltage and current of the given multisource circuit.	15	10	5
LE2.2	Apply the Thevenin theorem to determine output voltage and current of the given circuit.	15	10	5
LE2.3	Apply the Norton's theorem to determine output voltage and current of the given circuit.	15	10	5
LE2.4	Apply the maximum power transfer theorem to determine maximum power transferred to the load.	15	10	5
LE3.1	For series resonance circuit, determine the frequency response curve to obtain the resonant frequency, resonant impedance, and Bandwidth (BW) and Quality factor for series resonance circuit.	15	10	5
LE2.2	For a parallel resonance circuit, determine the frequency response curve to obtain the resonant frequency, resonant impedance.	15	10	5
LE3.3	Locate half power frequency on the characteristic curve of the following: LPF, HPF, BPF.	15	10	5
LE4.1	Determine the Y and Z parameter of a two-port network.	15	10	5
LE4.2	Determine the transmission and hybrid parameter of a two-port network.	15	10	5
LE4.3	Measure voltages and currents for the given circuit to calculate equivalent parameter of series/parallel connection of two port network.	15	10	5
LE5.1	Determine the transient and steady state response series RC circuit.	15	10	5

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE5.2	Determine the transient and steady state response for series RL circuit and also find out the time constant of the given circuit.	15	10	5

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend: PRA: Process Assessment, PDA : Product Assessment

Note: Only one experiment has to performed at the end semester examination of **30 Marks** as per assessment scheme

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author	Publisher	Edition & Year
1	Network Analysis & Synthesis	Chakraborty, A. K.; Ghosh, S.P.	Tata McGraw-Hill, New Delhi	1st edition, 2009 ISBN ;9780070144781
2	Network Analysis	Valkenburg,V.	Prentice Hall of India, N. Delhi	3rd edition, 2014 ISBN:9788120301566
3	Engineering Circuit Analysis	Hayt, W.H.	Tata McGraw-Hill, New Delhi	8th edition, 2013 ISBN: 9781259098635
4	Network, Lines and Fields	Ryder, John D.	Prentice Hall of India, N. Delhi	2nd edition, 2015 ISBN: 9789332559516
5	Introduction to network, Filters and Transmission Lines	Chakraborty, A. K.	Dhanpat Rai & Sons, New Delhi	ISBN: 1234567149104

S. No.	Titles	Author	Publisher	Edition & Year
6	Circuit and network	Sudhakar; Shyammohan,S.P.	Tata McGraw-Hill, New Delhi	5th edition, 2015 ISBN: 9789339219604
7	Electrical circuit analysis	Babu, Ramesh	Sci tech publisher, New Delhi	2nd edition,2010 ISBN: 9788183710787
8	Network Analysis & Synthesis	Singh,Ravish	Tata McGraw-Hill, New Delhi	1st edition,2013, ISBN: 9781259062957

(b) Open source software and website address:

1. nptel.ac.in/video.php?subjectId=108102042
2. www.slideserve.com/melodie-mckay/network-analysis
3. ext02.fh-kaernten.at/auer/intern/Subj/AEE/pdf/EE_01.pdf
4. www.eolss.net/Sample-Chapters/C05/E6-39A-01-04.pdf
5. elect.mrt.ac.lk/EE101_2_Network_Theorems.pdf
6. nptel.ac.in/courses/108105053/pdf/L-10(GDR)(ET) ((EE)NPTEL).pdf
7. www.cemtool.com/.../pages/trex/upfiles/file/file_20120629105152.pdf
8. www.ece.ubc.ca/~grecuc/253/spring14/253-P2-4-two-ports.pdf
9. www.swarthmore.edu/NatSci/echeeve1/Ref/DataSheet/IntroToFilters.pdf
10. www.ti.com/lit/an/snoa224a/snoa224a.pdf
11. Software for circuit simulation:-SimullDE
12. Software for circuit simulation:- Supersim

(c) Others:

1. Multisim software for circuit simulation
2. Tina pro for circuit simulation (www.tina.com)
3. ADS(Advance Design Software) software
4. SimullDE
5. SUPERSIM

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	CRO	Dual trace, 20MHz with component testing	All
2	Multimeter	Analog and Digital AC Voltage :0-400V, DCVoltage :0-24V AC current:0-10A, Dc current : 0-20A Resistance: 0-1K ohm	All
3	LCR meter	Digital display, separate range for L,R and C	LE3.1, LE3.2, LE3.3
4	Basic regulated variable power supply	0-24V, 1A	ALL
5	Signal Generator	Up to 2MHz	LE3.1, LE3.2, LE3.3 LE4.1, LE4.2

N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Analyze electrical circuit using basic law.	2	2	3	3	3	1	2	2	2	2	3	3
CO-2 Apply basic circuit theorems to simplify complicated circuits	2	2	3	3	3	1	2	2	2	2	3	3
CO-3 Analyze series and parallel resonance condition in the given circuit.	2	2	3	3	3	1	2	2	2	2	3	3
CO-4 Analyze the circuit using two port network theorem	2	2	3	3	3	1	2	2	2	2	3	3
CO-5 Analyze basic switching conditions and transient response	2	2	3	3	3	1	2	2	2	2	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-1 Analyze electrical circuit using basic law.	SO1.1 SO1.2 SO1.3 SO1.4	LE1.1 LE1.2	Unit-1.0 Basic concepts of networks	As mentioned in relevant page numbers
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-2 Apply basic circuit theorems to simplify complicated circuits.	SO2.1 SO2.2 SO2.3 SO2.4	LE2.1 LE2.2 LE2.3 LE2.4	Unit-2.0 **Network** Theorems	
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-3 Analyze series and parallel resonance condition in the given circuit.	SO3.1 SO3.2 SO3.3 SO3.4	LE3.1 LE 3.2 LE3.3	Unit-3.0Filters and Resonance circuits	
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-4 Analyze the circuit using two port network theorems.	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2 LE4.3	Unit-4.0 Two port network	
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-5 Analyze basic switching conditions and transient response.	SO5.1 SO5.2 SO5.3	LE5.1 LE5.2	Unit-5.0Transient and Steady state analysis	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

A) Course Code : 2028372(028)

B) Course Title : Instrumentation and Measurement System

C) Pre- requisite Course Code and Title : Electronic Devices and Circuits

D) Rationale :

In all type of manufacturing and assembling industry test and measuring instruments are frequently used for the parameters measurement and monitoring. Sensors and transducers are the basic building blocks of electronic automation systems. This course enables the student to understand the basic concepts and principles of electronic Instrumentation and Measurement system and also empower them to apply the same to handle the test and measuring equipment for the process parameters measurement and instrumentation purpose. This course will also help the student to develop various skills required to maintain test and measuring equipment, sensors and transducers, display and recording systems. Students will also develop skills to select the appropriate transducer for the specified application.

E) Course Outcomes:

CO-1 Analyze functions of basic elements of Instrumentation and Measurement system.

CO-2 Measure unknown value of different circuit elements like R, L and C with the help of different types of bridge method.

CO-3 Use test and measuring instrument to measure various parameters.

CO-4 Test the performance of the given transducer used for the specified application.

CO-5 Use various transducers to sense the given physical quantity.

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit L+T+(P/2)
1	E&TC Engineering	2028372(028)	Instrumentation and Measurement System	3	-	-	3
2	E&TC Engineering	2028362(028)	Instrumentation and Measurement System (Lab)	-	2	-	1

Legend : L-Lecture, P- Practical, T- Tutorial

G) Scheme of Assessment:

S.No.	Board of Study	Course Code	Course Title	Scheme of Examination					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1	E&TC Engineering	2028372(028)	Instrumentation and Measurement System	70	20	30	-	-	120
2.	E&TC Engineering	2028362(028)	Instrumentation and Measurement System (Lab)	-	-	-	30	50	80

Legend: ESE- End semester Exam, CT- Class test, TA- Teacher Assessment

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Analyze functions of basic elements of Instrumentation and measurement and system.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Differentiate between measurement and Instrumentation system. SO1.2 Describe the functions of the given block of basic measurement system. SO1.3 Define the given parameter of the measurement system. SO1.4 Describe the given static characteristics of measurement system. SO1.5 Calculate types of error in the given sample measurement.		**Unit-1.0 Introduction of Instrumentation and Measurement System** 1.1 Basic building blocks of Instrumentation and measurement system, functions of instruments and measurement system 1.2 Basic parameters of measurement system: Static characteristics- Accuracy & Precision, Sensitivity, Linearity, Hysteresis, Resolution, Repeatability, Reliability, Maintainability, Span, Calibration 1.3 Dynamic characteristic- speed of response, fidelity, lag, dynamic error 1.4 Definition of error, types of errors, definition of primary and secondary standard used in measurement system.	• Differentiate between accuracy and precision with example. • Explain the need for electrical standards used in measurement system. • Compare direct and indirect methods of measurement.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. List different types of errors that occur during measurement and explain each type of error with example.

ii. Describe different types of electrical standards used in measurement system.

iii. Differentiate between Static and Dynamic characteristics of measurement system.

b. Other Activities (Specify):

i. Prepare PPT on elements and functions of measurement system.
ii. Seminar on the latest test and measuring instrument used in the industry.

CO-2 Measure unknown value of different circuit elements like R, L and C with the help of different types of bridge method.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Obtain the value of unknown resistance using Wheat stone bridge. SO2.2 Apply Maxwell bridge method to obtain the value of unknown inductance. SO2.3 Apply Schering bridge method to obtain the value unknown inductance. SO2.4 Apply the Kelvin's double bridge to find the value unknown low resistance. SO2.5 State the importance of Wagner's earth connection in A.C. bridges SO2.6 Identify the need of instrument transformer.	LE2.1 Measure the resistance value of the given resistor using Whetstone Bridge. LE2.2 Measure inductance value of the given inductor with the help of Maxwell bridge. LE2.3 Measure capacitance of the given capacitor using Wein bridge. LE2.4 Measure the Q of the given coil with the help of appropriate bridge. LE2.5 Determine the frequency of the given source using Wine bridge.	**Unit-2.0 Bridges** 2.1 Introduction of bridge method and bridge balance, AC and DC bridges 2.2 Wheatstone Bridge and Kelvin's bridge for measurement of unknown resistance 2.3 Maxwell Bridge and Hay's bridge method for measurement of unknown inductance 2.4 Schering Bridge and Wien bridge method for measurement of unknown capacitance, Wagner's earth(ground)connection	• Compare DC and AC Bridges. • Measure frequency using the given Wine Bridge.

SW-2 Suggested Sessional Work (SW) :

a. Assignments:

i. Explain the step to measure the Q of the given capacitor.
ii. List the uses of different types of bridges.

b. Mini Project:

i. Build a bridge circuit for measurement of R, L, C.

c. Other Activities (Specify):

i. Presentation on application of Bridge method for the measurement of unknown circuit elements.
ii. Presentation on application of different types of D.C. and A.C. bridges.
iii. Demonstrate the use of RLC-Q meter to measure R, L, C and Q of the distributed components.

CO-3 Use test and measuring instrument to measure various parameters.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Describe the function of each block of CRO with the help of block diagram. SO3.2 Compare the functions of DSO and CRO. SO3.3 Describe the working function of signal generator with the help of suitable block diagram. SO3.4 Explain the steps to use spectrum analyzer for the radio signal analysis. SO3.5 State the important feature of LCDs and LEDs displays. SO3.6 Differentiate between indicator and recorder. SO3.7 List various types of recorders.	LE3.1 Measure frequency & Phase of the given signal using Lissajous pattern on DSO/CRO. LE3.2 Test the various functions of DSO front panel. LE3.3 Measure the resultant amplitude, frequency and phase of the two given signal waveforms. LE3.4 Measure the frequency response, power and distortion and harmonics of the given radio signal. LE3.5 Trace the spectrum of the given signal on the graph paper using spectrum analyzer.	**Unit-3.0 Test and Measuring Instruments** 3.1 Cathode Ray Oscilloscope (CRO): Block diagram of CRO, CRT and principle of operation, Vertical Amplifier, Time Base Generator, Trace Synchronization, Triggering Modes, Front Panel Controls, Probe Characteristics, Features of dual trace and dual beam oscilloscopes, chopper beam switch, alternate beam switch. 3.2 Digital Storage Oscilloscope (DSO) Basic block diagram, front panel functions, Measurement of amplitude, frequency, time period, storage and retrieval of wave form 3.3 Signal generator: principal of signal generation, descriptions, types of signals used in communication system, Basic block diagram 3.4 Spectrum analyser: Basic block diagram and its functions, applications, specifications 3.5 Records and Display devices: Fundamental of recorders and LED and LCD display techniques, types of recorders, applications of recorders	• Signal Generator applications. • Construction and features of LED and LCD display devices. • Need of Instrument Transformers and • Advantages of Instrument Transformers

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. List the application of spectrum analyzer.
ii. Compare the LCD and LED display.
iii. List the major functions of DSO.

b. Mini Project:

i. Collect technical specifications of DSO (of any five leading company) and prepare a report on it.

c. Other Activities (Specify):

i. Presentation on functions of CRO, DSO.
ii. Presentation on different types of display (LED, LCD).

CO-4 Test the performance of the given transducer used for the specified application.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain the principle of operation of analog transducer. SO4.2 Classify transducer on the basis of different parameter. SO4.3 Identify the factors for selecting a transducer. SO4.4 Explain the need for signal conditioning circuit.	LE4.1 Identify transducers and sensors available in the lab. LE4.2 Test the performance of the specific signal condition circuit. LE4.3 Test the performance of the given transducer.	**Unit-4.0 Transducer fundamentals** 4.1 Principle of operation of transducer and sensor 4.2 Classification of transducer: Electrical and Mechanical, Primary and Secondary, Active and Passive, Analog and Digital transducer 4.3 Factors for selecting a transducer 4.4 Parameter of electrical transducer: linearity, sensitivity, Dynamic range, repeatability, physical size 4.5 Signal conditioning: basic building blocks, need, functions and instrumentation amplifier	• Differentiate between sensors and transducers. • Advantage of electrical transducer over mechanical transducer.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Explain the difference between primary and secondary transducer with the help of example.
ii. State the various parameter of electrical transducer.

b. Mini Project:

i. Build a simple signal conditioning circuit for the specified application.

c. Other Activities (Specify):

i. Prepare presentation on classification of transducers.
ii. Seminar on the signal conditioning circuit.

CO-5 Use various transducers to sense the given physical quantity.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Select transducer for specific application. SO5.2 Describe strain gauge and state the importance of gauge factor. SO5.3 Describe the application of the given temperature transducer. SO5.4 Describe the principle of operation of the given type of capacitive transducer. SO5.5 Explain the steps to use LVDT for displacement measurement. SO5.6 Describe the use of Photo electric transducer in various application.	LE5.1 Measure the Weight of the given sample using strain gauge. LE5.2 Test the performance of the given load cell. LE5.3 Measure temperature of the given sample using thermocouple. LE5.4 Measure temperature of the given sample using Thermistor. LE5.5 Measure the thickness, length, electricity and liquid level of the given sample with the help of capacitive transducer. LE5.6 Measure the flow rate of the given liquid with the help of electromagnetic flow meter. LE5.7 Measure displacement with the help of LVDT transducer. LE5.8 Test the performance of the given photovoltaic cell.	**Unit-5.0 Applications of Transducers** 5.1 Measurement of physical quantity: pressure, displacement, temperature, level, flow, thickness 5.2 Strain gauge: - Resistance wire strain gauge and semiconductor strain gauge, piezo electric crystal, load cell 5.3 Temperature: RTD, Thermistor, Thermocouple, Pyrometer 5.4 Capacitive transducers 5.5 Linear variable differential transducer (LVDT) 5.6 Photo electric transducers: photo emissive, photo conductive, and photovoltaic transducer	• Difference between piezo resistive and piezo electric materials. • Summarize the applications of the given type of transducer.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. List the name of the five physical quantities that the given type of transducer sense.
ii. List the advantage and disadvantage of semiconductor strain gauge.

iii. Differentiate between Thermistor and thermocouple.
iv. Describe the principle of operation of pressure transducer employing each of the following principle (a) resistive transducer (b) capacitive transducer

b. Mini Project:

i. Prepare a chart for different types of temperature transducer of different temperature range.
ii. Prepare a circuit using appropriate transducer to measure water level of the water tank.

c. Other Activities (Specify):

i. Presentation on LVDT and RVDT
ii. Presentation on different types of temperature sensor.
iii. Presentation on the applications of Chemical transducer

Note: Performance under Laboratory and Sessional work may appear in more than one Cos/Sos.

I) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Introduction of Instrumentation and Measurement System	4	4	6	14
II	Bridges	3	5	6	14
III	Test and Measuring Instruments	4	5	5	14
IV	Transducer fundamentals	3	5	6	14
V	Applications of Transducers	2	6	6	14
Total		**16**	**25**	**29**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE2.1	Measure the resistance value of the given resistor using Whetstone Bridge.	15	10	5
LE2.2	Measure inductance value of the given inductor using Maxwell bridge.	15	10	5
LE2.3	Measure capacitance of the given capacitor using Wein bridge.	15	10	5
LE2.4	Measure the Q of the given coil using the appropriate bridge.	15	10	5
LE2.5	Determine the frequency of the given source using Wine bridge.	15	10	5
LE3.1	Measure frequency & Phase of the given signal using Lissajous pattern on DSO/CRO.	15	10	5
LE3.2	Test the various functions of DSO front panel.	15	10	5

	LE3.3	Measure the resultant amplitude, frequency and phase of the two given signal waveforms.	15	10	5
	LE3.4	Measure the frequency response, power and distortion and harmonics of the given radio signal.	15	10	5
	LE3.5	Trace the spectrum of the given signal on the graph paper using spectrum analyzer.	15	10	5
	LE4.1	Identify transducers and sensors available in the lab.	15	10	5
	LE4.2	Test the performance of the specific signal condition circuit.	15	10	5
	LE4.3	Test the performance of the given transducer.	15	10	5
	LE5.1	Measure the Weight of the given sample using strain gauge bridge.	15	10	5
	LE5.2	Test the performance of the given load cell.	15	10	5
	LE5.3	Measure temperature of the given sample using thermocouple.	15	10	5
	LE5.4	Measure temperature of the given sample using Thermistor.	15	10	5
	LE5.5	Measure the thickness, length, dielectricity and liquid level of the given sample using capacitive transducer.	15	10	5
	LE5.6	Measure the flow rate of the given liquid with the help of electromagnetic flow meter.	15	10	5
*	LE5.7	Measure displacement with the help of LVDT transducer.	15	10	5
As	LE5.8	Test the performance of the given photovoltaic cell.	15	10	5

sessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend: PRA: Process Assessment, PDA : Product Assessment

Note: Only one experiment has to performed at the end semester examination of **30** Marks as per assessment scheme

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Electrical and electronics measurements and instrumentation	Sawhney, A.K.	Dhanpat Rai& Co. New Delhi	3rd edition 2014 ISBN:- 978-8177001006 Or latest edition
2.	Electronics instrumentation	Kalsi, H.S.	Mc Graw Hill education(india) private limited, New Delhi	3rd edition 2010 ISBN:- 978-0-07-070206-6 Or latest edition
3.	Electrical and electronics measurements and instrumentation	Purkait, Prithwiraj; Biswas, Budhaditya; Das, Santanu; Koley, Chirajib	Mc Graw Hill education(india) private limited , New Delhi	2017 edition, ISBN:-978-1-25-902959-2 Or latest edition
4.	Electrical and electronics measurements and instrumentation	Rajput,R.K.;	S.CHAND, New Delhi	4th edition,2016 ISBN:- 978-9385676017 Or latest edition
5.	Electronic measurements and instrumentation	David A. Bell	OXFORD University Press India, New Delhi	3rd edition, 2013 ISBN:- 978-0195696141 Or latest edition

(b) Open source software and website address:

i. https://en.wikipedia.org/wiki/Spectrum_analyzer
ii. http://www.hit.ac.il/.upload/engineering/experiment_1_spectrum_analyzer.pdf
iii. http://www.gatestudymaterial.com/study-material/emi/text%20books/A%20course%20in%20Electrical%20and%20Electronic%20Measurements%20and%20Instrumentation%20-%20A.K.Sawhney.pdf

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	CRO	50 MHz, dual trace, dual beam, in built +-5v supply, component tester, in built function generator	LE3.1
2	DSO	Bandwidth 50MHz to 100MHZ,Real-time Sampling Rate 500 MSa/s, Equivalent Sampling Rate 50GSa/s., Memory Depth: 32Kpts,Trigger types: Edge, Pulse width, Video, Slope, Alternative, e Digital Filter function and Waveform Recorder function, Support pass/fail function, Auto Measure function, Save/recall types: Setups, Waveforms, CSV file, Picture, Waveform Intensity and grid brightness can be adjusted, Standard configuration port: USB Host: Support USB flash driver save/recall function and	LE3.1,LE3.2,LE3.3

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
		update firmware, USB Device: Support PICT Bridge compatible printer and support PC remote control, RS232	
3	Digital multimeter	Digital multimeter 3 and ½ digit with component tester	LE2.1 to LE2.5 LE4.2 to LE4.3
4	Function generator	0-2 MHz with sine ,square and triangular wave output with variable frequency and amplitude	LE2.3,LE2.4,LE3.1,LE3.2,
5	Spectrum analyzer	Frequency range: 10 Hz to 44 GHz Resolution Bandwidth: 1 Hz to 8 MHz Noise Floor/Dynamic range: -163 dBm to +30 dBm	LE3.4
6	Wheat stone bridge	Measuring range : 1Ohm-10MegaOhm Accuracy : Range, ±0.1% of reading on 100Ω to 100kΩ Range, ±0.3% of reading on 10Ω to 1MΩ Range, ±0.6% of reading on 1Ω to 10MΩ Range Temperature coe. Of resistance element: ±0.5 x 10^{-5} /°C at ambient temperature of 5 to 35°C (41 to 95°F), ±2 x 10^{-5} /°C at ambient temperature of 20 to 35°C (68 to 95°F)	LE2.1
7	Transducer trainer kit	4 different Temperature Transducers, Study of Transducer controlled switching / alarm systems, LVDT, Strain gauge, Burdon tube, hall effect transducer, Phizo electric transducer, photo voltaic transducer ,On board signal conditioning circuitry, Built-in DC Power Supply, Functional blocks indicated on-board Mimic	LE5.1 to LE5.8

N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)		Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
		PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1	Analyze functions of basic elements of Instrumentation and Measurement system.	1	2	2	2	1	1	1	2	1	1	3	3
CO-2	Measure unknown value of different circuit elements like R, L and C with the help of different types of bridge method.	1	2	2	2	1	1	1	2	1	2	3	3
CO-3	Use test and measuring instrument to measure various parameters.	1	2	2	3	1	1	1	2	1	2	3	3
CO-4	Test the performance of the given transducer used for the specified application.	1	2	2	3	1	1	1	2	1	2	3	2
CO-5	Use various transducers to sense the given physical quantity.	1	2	2	3	1	1	1	2	1	2	3	2

Legend: 1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1 Analyze functions of basic elements of Instrumentation and measurement and system.	SO1.1, SO1.2 SO1.3, SO1.4 SO1.5		Unit 1.0 Introduction Of Instrument & Measurement System 1.1, 1.2, 1.3, 1.4	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2 Measure unknown value of different circuit elements like R, L and C with the help of different types of bridge method.	SO2.1, SO2.2 SO2.3, SO2.4 SO2.5,SO2.6	LE2.1 LE2.2 LE2.3 LE2.4 LE2.5	Unit 2.0 0 R, L, C Measurement & Instrument Transformer 2.1, 2.2 2.3, 2.4	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3 Use test and measuring instrument to measure various parameters.	SO3.1, SO3.2 SO3.3, SO3.4 SO3.5,SO3.6, SO3.7	LE3.1 LE3.2 LE3.3 LE3.4 LE3.5	Unit 3.0 Test and Measuring instruments 3.1, 3.2 3.3, 3.4 3.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4 Test the performance of the given transducer used for the specified application.	SO4.1, SO4.2 SO4.3, SO4.4	LE4.1 LE4.2 LE4.3	Unit 4.0 Transducer fundamental 4.1, 4.2, 4.3 4.4, 4.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5 Use various transducers to sense the given physical quantity.	SO5.1, SO5.2 SO5.3, SO5.4 SO5.5, SO5.6	LE5.1, LE5.2 LE5.3, LE5.4 LE5.5, LE5.6 LE5.7, LE5.8	Unit 5.0 Applications of transducer 5.1, 5.2 5.3, 5.4 5.5, 5.6	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others) , LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

A) Course Code : 2028373(028)

B) Course Title : Analog Electronic Circuit - I

C) Pre- requisite Course Code and Title : Electronic Devices and Circuits

D) Rationale:

Analog Electronic circuits are the most important part of industrial equipment, automation and communication systems. Concept of analog circuit analysis and working helps in maintain and troubleshoot different types of analog circuits. This course will help the students to maintain various electronic circuits consists of analog components and will also develop the skills to troubleshoot the circuits frequently used in automation and communication Industries.

E) Course Outcomes:

CO-1 Analyze transistor amplifier at low frequency.

CO-2 Analyze single stage and multistage transistor amplifiers at high frequency.

CO-3 Test the performance of feedback amplifier.

CO-4 Build and test various types of oscillators.

CO-5 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit L+T+(P/2)
1	E&TC Engineering	2028373(028)	Analog Electronic Circuit - I	3	-	-	3
2	E&TC Engineering	2028363(028)	Analog Electronic Circuit - I (Lab)	-	2	-	1

Legend: L-Lecture, P- Practical, T- Tutorial

G) Scheme of Assessment:

S.No.	Board of Study	Course Code	Course Title	Scheme of Examination					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1	E&TC Engineering	2028373(028)	Analog Electronic Circuit - I	70	20	30	-	-	120
2	E&TC Engineering	2028363(028)	Analog Electronic Circuit - I (Lab)	-	-	-	30	50	80

Legend: ESE- End semester Exam, CT- Class test, TA- Teacher Assessment

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Analyze the transistor amplifier at low frequency.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Explain the need for h- parameters to analyze performance of a transistor. SO1.2 Explain the steps to determine the h-parameters of the given type of transistor configuration. SO1.3 Compare the h-parameter of CE, CB and CC configurations. SO1.4 Apply the Miller's theorem to analyze the given transistor amplifier.	LE1.1 Determine the operating point, load line, input impedance, output impedance, voltage gain and forward current gain of CE configuration. LE1.2 Determine the operating point, load line, input impedance, output impedance, voltage gain and forward current gain of CB configuration. LE1.3 Determine the operating point, load line, input impedance, output impedance, voltage gain and forward current gain of CC configuration.	**Unit-1.0 Transistor at Low Frequency** 1.1 h-parameter: Need for h-parameter model of transistor, calculation of input impedance, output impedance, current gain and voltage gain 1.2 Comparison of CE, CB, CC h-amplifier circuit based on h-parameter concept, voltage gain, current gain, input impedance, output impedance and load line analysis 1.3 Miller's theorem for analysis of common emitter amplifier with collector to base bias 1.4 Simplified model of transistor	• List applications of CE, CB, and CC transistor configurations. • Differentiate between the circuits in which transistor is used as a switch and as an amplifier.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Calculate the performance parameters of CE, CB and CC amplifier for R_L = 2K, Rs=2K.

ii. Describe the effect of R_e on voltage gain of CE configuration.

b. Mini Project:

i. Obtain the 3 dB cut off frequency and gain of a CE amplifier with Rc = 2K and biasing resistors R_1=100K, R_2=100K.

c. Other Activities (Specify):

i. Organized a Seminar on importance of h- parameters for transistor analysis.

CO-2 Analyze single stage and multistage transistor amplifiers at high frequency.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Describe hybrid π model for CE configuration. SO2.2 Compare hybrid π model with h-parameter model for CE and CC configuration. SO2.3 Describe the working of RC coupled transistor amplifier. SO2.4 Differentiate various types of coupled amplifier. SO2.5 Explain various types of multistage amplifier. SO2.6 Suggest the coupling for the given application.	LE2.1 Determine voltage gain and 3 dB frequency of CE transistor amplifier by plotting the frequency response. LE2.2 Determine voltage gain and 3 dB frequency of CB transistor amplifier by plotting the frequency response. LE2.3 Determine voltage gain and 3 dB frequency of CB transistor amplifier by plotting the frequency response. LE2.4 Determine voltage gain and 3 dB frequency of RC coupled transistor amplifier by plotting the frequency response.	**Unit-2.0 Transistor at High Frequency and Multistage Amplifier** 2.1 Hybrid π model in CE and CC configuration 2.2 Relation between hybrid π and h-parameter model 2.3 Need of multistage amplifier, direct coupled multistage. 2.4 RC coupled and transformer coupled multistage amplifier 2.5 Selection of amplifier configuration for multistage amplifiers	• Comparison of all multistage amplifiers. • Summarize advantages and disadvantages of multistage amplifiers.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Obtain hybrid π parameters in terms of h- parameters.

ii. Explain the selection criteria amplifier configurations used for multistage amplifier.

b. Mini Project:

i. Realize two stage(CB-CE) and two stage (CE-CE) amplifier and compare the output response of both.

c. Other Activities (Specify):

i. Identify the low frequency and high frequency amplifiers amplifier used in AM and FM radio and describe its working.

CO-3 Test the performance of feedback amplifier.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain the basic concept of feedback amplifier. SO3.2 Discuss various types of feedback topologies. SO3.3 Explain the effect of negative feedback on the amplifier performance. SO3.4 Discuss the effect of noise in amplifier.	LE3.1 Determine voltage gain and 3 dB frequency of Voltage series feedback transistor amplifier by plotting the frequency response. LE3.2 Determine voltage gain and 3 dB frequency of Voltage shunt feedback transistor amplifier by plotting the frequency response. LE3.3 Determine voltage gain and 3 dB frequency of current series feedback transistor amplifier by plotting the frequency response. LE3.4 Determine voltage gain and 3 dB frequency of current shunt feedback transistor amplifier by plotting the frequency response.	**Unit-3.0 FEEDBACK AMPLIFIERS** 3.1 Types of feedback, positive and negative feedback in the amplifiers 3.2 Effect of negative feedback on gain, stability, distortion, noise, bandwidth and phase shift. 3.3 Effect of negative feedback on input and output impedance 3.4 Feedback topologies: Voltage series, Voltage shunt, current series, current shunt 3.5 Distortions in amplifiers 3.6 Noise in the amplifier circuits	• Advantages and disadvantages of positive and negative feedback in the amplifiers. • Applications of Positive and Negative feedback amplifiers.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the advantages and disadvantages of negative feedback.

ii. Discuss various types of distortions in an amplifier circuit.

b. Mini Project:

i. Make a voltage series feedback amplifier on bread board and observe the change in gain of amplifier by changing the amount of feedback.

c. Other Activities (Specify):

i. Organize Seminar on application of amplifiers in all domestic electronic equipment.

CO-4 Build and test various types of oscillators.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain the Barkhausen criteria of oscillation. SO4.2 Explain the mechanism to start oscillation and Stabilization in the given circuit. SO4.3 Compare working of various types of sinusoidal oscillators. SO4.4 Describe the working of crystal oscillator.	LE4.1 Determine the frequency of oscillation of RC phase shift oscillator. LE4.2 Determine the frequency of oscillation of wein bridge oscillator. LE4.3 Determine the frequency of oscillation of Hartley and Colpitt oscillator. LE4.4 Determine the frequency of oscillation of Crystal controlled oscillator.	**Unit-4.0 Oscillators** 4.1 Concept of oscillation – oscillation condition in the amplifier circuit, Barkhausen criteria 4.2 Mechanism for start of oscillation and Stabilization of amplitude in the oscillator circuit 4.3 Sinusoidal oscillator: RC Phase shift oscillators, Wien Bridge oscillator, Resonant circuit oscillators, Colpitt and Hartley oscillator 4.4 Crystal controlled oscillator	• Summarize Frequency range of various oscillators • Difference between series and parallel resonance frequency. • Crystal oscillator.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the Barkhausen criteria for oscillation in any electronics circuit.

ii. Explain series and parallel frequency of operation in crystal oscillator.

b. Mini Project:

i. Simulate Hartley and Colpitt oscillator in circuit simulation software.

c. Other Activities (Specify):

i. List the electronic equipment of your Institutes' lab containing oscillators.

CO- 5 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Explain characteristics of the given type of power amplifiers. SO5.2 Define quality factor and bandwidth of tuned amplifier. SO5.3 Describe working principle of the given type of tuned	LE5.1 Observe the waveform and find the efficiency of the given class A amplifier. LE5.2 Observe the waveform and find the efficiency of the given class B amplifier. LE5.3 Observe the waveform and find the efficiency of the given class B	**Unit-5.0 Power Amplifier and Tuned Amplifier** 5.1 Characteristics of Class A, Class B, Class C and Class AB amplifier. 5.2 Difference between voltage and power amplifiers 5.3 Circuit operation of Transformer Coupled	• Compare various types of power amplifiers. • Discuss application of various types of power amplifiers. • Differentiate

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
amplifier.	push pull amplifier. LE5.4 Observe the waveform and find the efficiency of the given class C amplifier. LE5.5 Observe the waveform and find the efficiency of the given class AB amplifier.	Class Amplifier, Class B Push Pull amplifier and Class C amplifier 5.4 Tuned Amplifier: Tuned circuit, quality factor and bandwidth 5.5 Single tuned radio frequency amplifier and double tuned radio frequency amplifier	between single and double tuned amplifier.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. What are the performance parameters of a power amplifier?
ii. List the applications of tuned amplifier.

b. Mini Project:

i. Prepare a list of power ratings of power amplifiers used for different domestic applications.

c. Other Activities (Specify):

i. Demonstrate the difference between power amplifier and voltage amplifier in the lab.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Transistor at Low Frequency	4	4	6	14
II	Transistor at High Frequency and Multistage Amplifier	3	5	6	14
III	Feedback Amplifiers	4	5	5	14
IV	Oscillators	3	5	6	14
V	Power Amplifier and Tuned Amplifier	2	6	6	14
Total		**16**	**25**	**29**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

S. No.	List of Practical's	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	

S. No.	List of Practical's	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Determine the operating point, load line, input impedance, output impedance, voltage gain and forward current gain of CE configuration.	15	10	05
LE1.2	Determine the operating point, load line, input impedance, output impedance, voltage gain and forward current gain of CB configuration.	15	10	05
LE1.3	Determine the operating point, load line, input impedance, output impedance, voltage gain and forward current gain of CC configuration.	15	10	05
LE2.1	Determine voltage gain and 3 dB frequency of CE transistor amplifier by plotting the frequency response.	15	10	05
LE2.2	Determine voltage gain and 3 dB frequency of CB transistor amplifier by plotting the frequency response.	15	10	05
LE2.3	Determine voltage gain and 3 dB frequency of CB transistor amplifier by plotting the frequency response.	15	10	05
LE2.4	Determine voltage gain and 3 dB frequency of RC coupled transistor amplifier by plotting the frequency response.	15	10	05
LE3.1	Determine voltage gain and 3 dB frequency of Voltage series feedback transistor amplifier by plotting the frequency response.	15	10	05
LE3.2	Determine voltage gain and 3 dB frequency of Voltage shunt feedback transistor amplifier by plotting the frequency response.	15	10	05
LE3.3	Determine voltage gain and 3 dB frequency of current series feedback transistor amplifier by plotting the frequency response.	15	10	05
LE3.4	Determine voltage gain and 3 dB frequency of current shunt feedback transistor amplifier by plotting the frequency response.	15	10	05
LE4.1	Determine the frequency of oscillation of RC phase shift oscillator.	15	10	05
LE4.2	Determine the frequency of oscillation of wein bridge oscillator.	15	10	05
LE4.3	Determine the frequency of oscillation of Hartley and Colpitt oscillator.	15	10	05
LE4.4	Determine the frequency of oscillation of Crystal controlled Oscillator.	15	10	05
LE5.1	Observe the waveform and find the efficiency of the given class-A amplifier.	15	10	05
LE5.2	Observe the waveform and find the efficiency of the given class-B amplifier.	15	10	05
LE5.3	Observe the waveform and find the efficiency of the given class-B push pull amplifier.	15	10	05

S. No.	List of Practical's	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE5.4	Observe the waveform and find the efficiency of the given class-C amplifier.	15	10	05
LE5.5	Observe the waveform and find the efficiency of the given class-AB amplifier.	15	10	05

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practical

Legend: PRA: Process Assessment, PDA: Product Assessment

Note: Only one experiment has to perform at the end semester examination of **30** Marks as per assessment scheme

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Electronic devices and circuit	Godse and Bakshi	Technical publications, Pune	1st Edition ,2009 Or latest edition
2.	Integrated Electronics: analog and digital	Jacob Millman, Christos C. Halkias	Tata McGraw-Hill, New Delhi	3rd Edition ,2010 Or latest edition
3.	Basic Electronics and Linear circuits	N.N. Bhargava, D.C. Kulshreshtha, S.C. Gupta	Technical education series, New Delhi	2nd Edition ,2013 Or latest edition
4.	Principles of Electronics	V.K.Mehta	S. Chand and Company ltd., New Delhi	3rd Edition ,2005 Or latest edition
5	Microelectronic circuits	Sedra and smith	Oxford University Press, New Delhi	6th Edition,2009 Or latest edition

(b) Open source software and website address:

1. CEconfigurations:-http://studentboxoffice.in/jntuh/notes/electronic-devices-and-circuits-lab/input-and-output-characteristics-of-ce-configuration-and-h-parameter-calculations/7
2. Class A amplifier-http://www.electronics-tutorials.ws/amplifier/amp_5.html
3. Power amplifier- http://www.learnabout-electronics.org/Amplifiers /amplifiers50.php
4. Tuned amplifier-http://ecetutorials.com/question-answers/amplifier-question-and-answers-2/tuned-ampli
5. Book-https://www.amazon.in/Basic-Electronics-Linear-Circuits-Bhargava/dp/1259006468

(c) Others:

1. Learning Packages.
2. Lab Manuals.
3. Manufacturers' Manual
4. Users' Guide

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Multimeter	Analog and Digital AC voltage:0-400 V,DC Voltage:0-24V AC Current:0-20A,DC Current:0-20 A	All
2	CRO	60 MHz, Dual Channel, Dual Trace With Component Tester	All
4	Function generator	0 -2 MHz with Sine, Square, Triangular wave output With Variable Frequency and output	LE4.1 to LE4.4 LE5.1 to LE5.5
5	Variable DC supply	0 to 30 V DC dual power supply	All
6	Digital Multimeter	3 and ½ digit with component Tester	All

N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Analyze transistor amplifier at low frequency.	1	2	2	2	1	1	1	2	1	1	3	3
CO-2 Analyze single stage and multistage transistor amplifiers at high frequency.	1	2	2	2	1	1	1	2	1	1	3	3
CO-3 Test the performance of feedback amplifier.	1	2	2	2	1	1	1	2	1	1	3	3
CO-4 Build and test various types of oscillators.	1	2	2	2	1	1	1	2	1	1	3	3
CO-5 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.	1	2	2	2	1	1	1	2	1	1	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1 Analyze transistor amplifier at low frequency.	SO1.1 SO1.2 SO1.3 SO1.4	LE1.1 LE1.2 LE1.3	Unit 1.0 Transistor at Low Frequency 1.1, 1.2 1.3, 1.4	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2 Analyze single stage and multistage transistor amplifiers at high frequency.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6	LE2.1 LE2.2 LE2.3 LE2.4	Unit 2.0 Transistor at High Frequency and Multistage Amplifier 2.1, 2.2 2.3, 2.4 2.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3 Test the performance of feedback amplifier.	SO3.1 SO3.2 SO3.3 SO3.4	LE3.1 LE3.2 LE3.3 LE3.4	Unit 3.0 Feedback Amplifiers 3.1, 3.2 3.3, 3.4 3.5, 3.6	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4 Build and test various types of oscillators.	SO4.1 SO4.2 SO4.3 SO4.4	LE4.1 LE4.2 LE4.3 LE4.4	Unit 4.0 Oscillators 4.1, 4.2 4.3, 4.4	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.	SO5.1 SO5.2 SO5.3	LE5.1 LE5.2 LE5.3 LE5.4 LE5.5	Unit 5.0 Power Amplifier and Tuned Amplifier 5.1, 5.2 5.3, 5.4 5.5	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others) , LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

A) Course Code : 2028374(028)
B) Course Title : Digital Electronics
C) Pre- requisite Course Code and Title : Electronics Devices and Circuits
D) Rationale :

Digitization of automation industries and communication systems has changed the complete Industrial scenario and human lifestyle across the globe. The advancement in microelectronics integrated circuits, manufacturing of VLSI and ULSI chips, computer technology and information systems have caused the rapid increase in the use of digital circuits. Hence this subject is intended to learn facts, concepts, principles and procedures of digital techniques and their application used in digital circuits and systems. Concepts of this course will help the students to develop skills to analysis and built applications based on digital Integrated circuits.

E) Course Outcomes:

CO-1 Use number systems and codes for various applications.

CO-2 Test the functionality of various types of logic gates.

CO-3 Build and test various types of combinational circuits.

CO-4 Build and test various types of sequential circuits.

CO-5 Maintain various types of A/D converters, D/A converters.

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit L+T+(P/2)
1	E&TC Engineering	2028374(028)	Digital Electronics	2	-	1	3
2	E&TC Engineering	2028364(028)	Digital Electronics (Lab)	-	2	-	1

Legend: L-Lecture, P- Practical, T- Tutorial

G) Scheme of Assessment:

S.No.	Board of Study	Course Code	Course Title	Scheme of Examination					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1	E&TC Engineering	2028374(028)	Digital Electronics	70	20	30	-	-	120
2	E&TC Engineering	2028364(028)	Digital Electronics (Lab)	-	-	-	30	50	80

Legend: ESE- End semester Exam, CT- Class test, TA- Teacher Assessment

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Use number systems and codes for various applications.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Convert the given number into the given type of number system. SO1.2 Identify the various types of binary codes. SO1.3 Differentiate between weighted and non weighted code with example. SO1.4 Apply the arithmetic operation on the given binary numbers.	LE1.1 Implement and test 4-bit binary to gray code conversion. LE1.2 Implement and test 4-bit gray code to binary code conversion. LE1.3 Implement and test parity code conversion.	**Unit-1.0 NUMBER SYSTEM and CODES** 1.1 Number systems and codes for various applications, base conversion of Number systems 1.2 Conversion between different number systems 1.3 r's and (r-1)'s complement of number 1.4 Binary Arithmetic operations : Addition, Subtraction, Multiplication and Division 1.5 Binary Codes Weighted and Un-weighted codes, Excess- 3 code, Gray code, Error Detection and Correction Code, Hamming code, BCD Code, ASCI code	• Describe application of various types of codes. • Practice to convert base of number systems as specified.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Generate a hamming code for the data word 11000100.
ii. Perform the conversion and arithmetic operation between the different types of number system.
iii. Determine r' and (r-1)' complement for different types of number system.

b. Mini Project:

i. Prepare a report on the applications of binary codes.
ii. Describe properties of weighted and non-weighted codes.

c. Other Activities (Specify):

i. Quiz on number system conversion.

CO-2 Test the functionality of various types of logic gates.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Interaction (CI)	Self Learning (SL)
SO2.1 Explain functions of the given type of logic gate with the help of truth table. SO2.2 Apply Boolean algebra rules to minimize the given logic expression. SO2.3 Design simple logic circuits using logic gates. SO2.4 Apply the De-Morgan's theorem to simplify the given logic expression. SO2.5 Minimize given logic expression using K-map method.	LE2.1 Test the functionality of following Logic Gates: AND, OR, NOT, NAND and NOR gates (For TTL logic gates and CMOS logic gates). LE2.2 Implement and test the basic gates using NAND gates. LE2.3 Implement and test the basic gates using NOR gates. LE2.4 Simplify and implement the given Boolean functions using NAND gates.	**Unit -2 Logic gates and Boolean algebra** 2.1 Logic Gates: basic gates, AND, OR, NOT, EX-OR, EX-NOR, Universal Gates: NAND, NOR, 2.2 truth table ,symbol, implement Basic Gate using universal gate 2.3 Boolean Algebra: Boolean theorems, De Morgan's Theorems, duality Max - term, Min - term, Sum of product (SOP) and Product of Sum(POS) expressions, Simplify the Boolean functions,, Simplify the Boolean functions using K- map method(up to 4 variables)	• Simplify the given Boolean function up to 5 variables using K-map method. • Obtain standard SOP and POS form for the given expression.

SW-2 Suggested Sessional Work (SW) :

a. Assignments:

i. Show that both NAND and NOR gate are universal gate.

ii. Draw the logic symbols, construct the truth table, and with the help of circuit diagram explain the working of following gate
i) AND ii) OR iii) NOT iv) NAND v) NOR

iii. Explain the procedure to expand an SOP and POS expression into standard SOP form and standard POS form with suitable example.

b. Mini Project:

i. Prepare an application (like series parallel control circuit) based on logic gates.

c. Other Activities (Specify):

i. Seminar on applications of different types of logic Gates.

CO- 3 Build and test various type combinational circuits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Write step by step procedure to realize any combinational circuit. SO3.2 Design a full adder using half adder. SO3.3 Describe with sketches working of 4bit paraller adder. SO3.4 List applications of encoder and decoders. SO3.5 Design 4X1 multiplexer using 2X1 multiplexer. SO3.6 Design a 3 bit magnitude comparator.	LE3.1 Build and test half-adder and full-adder. LE3.2 Build and test half and full subtractor. LE3.3 Implement and test 2X1 multiplexer using AND and OR gates. LE3.4 Build 4X1 multiplexer using 2X1 multiplexers. LE3.5 Build and test BCD to seven segment decoder.	**Unit-3.0 Combinational Circuits** 3.1 Half Adder, Full Adder, Half subtractor, Full Subtractor, parallel adder, 4 bit binary adder, 4 bit binary Subtractor, BCD adder 3.2 Magnitude comparator(2 ,3 and 4 bit) 3.3 Encoder and Decoder: 4 I/P and 2 O/P encoder,8 I/P and 3 O/P encoder, Octal to Binary and Decimal to BCD Encoder Decoders: 3-Line to 8-Line Decoder, 8-4-2-1 BCD to Decimal Decoder, BCD to Seven Segment Decoder 3.4 Multiplexer(Mux) and Demultiplexer (Demux): 2X1,4X1 and 8X1 multiplixer,1X2,1X4 and 1X8 demultiplexer, applications of Multiplexers and demultiplexers	• Explain priority encoder circuit with justification. • Realize 4bit binary adder circuit using Mux and Demux.

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. Realize a full adder using
i) Only NAND gate ii) Only NOR gate
i. Discuss applications (any two) of multiplexer.
ii. Show an arrangement to obtain a 16 input mux from two 8 input mux.

b. Mini Project:

i. Design BCD to 7 segment decoder using IC7447.
ii. Design 4 bit binary adder/subtractor using IC7483.

c. Other Activities (Specify):

i. Prepare a PPT on all the combinational circuits.
ii. Prepare a chart to show the applications of Combinational circuits.

CO-4 Build and test various sequential circuits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain working of the given F/F with the help of excitation table. SO4.2 Describe design procedure of Mod -10 up and down counter. SO4.3 Differentiate characteristic of synchronous and asynchronous counter. SO4.4 Sketch the timing diagram of the output of each F/F of 4-bit serial in serial out shift register for the given input.	LE4.1 Test the functionality of SR, D, JK and T Flip-flops. LE4.2 Build and test binary Mod-4 synchronous and asynchronous counter. LE4.3 Build and test Mod-8 up / down counter. LE4.4 Test the output of the shift register (SISO, SIPO). LE4.5 Build and test Mod-10 counter using D or T F/F.	**Unit-4 SEQUENTIAL CIRCUITS** 4.1 Flip Flop(F/F) - basic flip flop and latch, Clock, Set and Reset inputs to F/F, clock triggering - Positive and Negative clock Edge triggering, level triggering, difference between latch and flip flop, RS, JK, D and T F/F, truth table, characteristic table or excitation table 4.2 Race around condition, Master Slave F/F 4.3 Counters:- Modules of a counter, synchronous and asynchronous counter, Ripple Counter, Up – down binary counter, Decade counter, BCD counter, Designing of counters 4.4 Register –Shift register, Serial in parallel out(SIPO), Serial in Serial out(SISO), Parallel in Serial out(PIPO), Parallel in Parallel out register(PISO), designing of register	• Develop modulo- 10 counter using D Flip-Flop and T-flip flop. • Differentiate between latch and flip flop. • Test the functionality of the given F/F using simulation software.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i Distinguish between combinational and sequential logic circuit.

ii Explain the procedure to convert one flip flop to another flip flop (Like: JK F/F to SR F/F.)

b. Mini Project:

i. Design 4 bit synchronous counter using IC7476.

ii. Design decade counter using IC7492/93.

c. Other Activities (Specify):

i. Prepare a PPT on all the applications of sequential circuit in the digital systems.

ii. Prepare a chart to show the difference between sequential and combinational circuits.

CO-5 Maintain various types of A/D converters, D/A converters.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 With the help of circuit diagram describe the working of following i) R-2R DAC ii) Weighted resistor DAC. SO5.2 With the help of circuit diagram describe the working of following: i) Counter type ADC ii) Flash ADC iii) Successive Approximation ADC Compare technical specifications of different logic families.	LE5.1 Test the input and output voltages of IC ADC0808. LE5.2 Test the input and output voltages of ICDAC0808. LE5.3 Test the parameters of TTL Inverter IC. LE5.4 Test the parameters of TTL and NAND IC. LE5.5 Test the parameters of CMOS Inverter IC. LE5.6 Test the parameters of CMOS NAND IC	**Unit-5 CONVERTERS and LOGIC FAMILIES** 5.1 Digital to Analog converter(DAC): R-2R DAC, Weighted resister DAC 5.2 Analog to Digital converter(ADC) Counter type, ramp, Successive approximation, Flash type 5.3 Logic Families – Digital IC specifications (threshold voltage , propagation delay, power dissipation, Fan in ,Fan out, transition width, logic levels, noise margin , speed power product and figure of merit), TTL, RTL, DTL ,ECL, $I^2L$and CMOS logic family characteristics.	• Compare various logic families. • Develop R-2R ladder network for the specified analog output. • Describe function of the given type of ADC.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. With the help of neat diagram explain the working of following DAC and ADC
i) R-2R ii) weighted resistor type DAC iii) Counter type ADC
iv) Flash type ADC v) Successive Approximation type ADC

b. Mini Project:

i. On the basis of Internet search prepare a report to summarize technical specifications of ADC and DAC ICs.

c. Other Activities (Specify):

i. Prepare a PPT on logic family

ii. Prepare PPT on DAC and ADC

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Number System and Codes	4	4	6	14
II	Logic Gates and Boolean Algebra	3	5	6	14
III	Combinational Circuits	4	5	5	14
IV	Sequential Circuits	3	5	6	14
V	Converters And Logic Families	2	6	6	14
Total		**16**	**25**	**29**	**70**

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
1	Implement and test 4bit binary to gray code.	15	10	5
2	Implement and test 4bit gray code to binary code.	15	10	5
3	Test the functionality of following Logic Gates: AND, OR, NOT, NAND and NOR Gates (For TTL logic gates and CMOS logic gates).	15	10	5
4	Implement and test the basic gates Using NAND gates.	15	10	5
5	Implement and test the Basic Gates Using NOR gates.	15	10	5
6	Simplify and implement the given Boolean functions using NAND gates.	15	10	5
7	Build and test half-adder and full-adder.	15	10	5
8	Build and test half and full subtractor.	15	10	5
9	Implement and test 2X1 multiplexer using AND and OR gates.	15	10	5
10	Build 4X1 multiplexer using 2X1 multiplexers.	15	10	5
11	Build and test BCD to seven segment decoder	15	10	5
12	Test the functionality of SR, D, JK and T Flip-flops.	15	10	5
13	Build and test binary Mod-4 synchronous and asynchronous counter.	15	10	5
14	Build and test Mod-8 up / down counter.	15	10	5
15	Test the output of the shift register (SISO, SIPO).	15	10	5

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
16	Build and test Mod-10 counter using D or T FF	15	10	5
17	Test the input and output voltages of IC ADC0808.	15	10	5
18	Test the input and output voltagesof ICDAC0808	15	10	5

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend : PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of **30** Marks as per assessment scheme

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Digital Logic and Computer Design	Mano M. Morris	Pearson India pvt. Limited, New Delhi	1st edition, 2016, ISBN:9789332542525
2.	Digital Electronics: Principle Devices and Applications	Maini, Anil K.	John Wiley &Sons Ltd., New Delhi	1st edition,2007 ISBN:9788126514663
3.	Digital Principles and Applications	Malvino and Leach	Tata McGraw-Hill, New Delhi	8th edition, 2014 ISBN: 9789339203405
4.	Fundamental Digital Circuits	KUMAR, A. ANAND	Prentice Hall of India, New Delhi	4th edition ISBN: 9788120352681
5.	Modern Digital Electronics	R.P. Jain	Tata McGraw-Hill	4th edition ,2009 ISBN: 9780070669116
6.	Digital Circuits and Design	A. Arivazhgan	Vikash Publishing House, New Delhi	2nd edition, 2003 ISBN: 9788125914358
7.	Digital Electronics and Logic Design	Sharma Sanjay	Kataria& Sons, New Delhi	2015 ISBN: 9789350141991
8.	Digital Fundamentals	Thomas L. Floyd	Pearson India, New Delhi	10th edition, 2011 ISBN: 9788131734483

S. No.	Titles	Author	Publisher	Edition & Year
9.	Digital Systems: Principles and Applications	Neal S. Widmer, Ronald J. Tocci, Gregory L. Moss	Pearson India, New Delhi	10th edition, 2009 ISBN: 9788131727249
10.	Digital Electronicy	Mamta Agrawal	Deepak Prakasahn	2016 ISBN: 8177762249 ISBN: 978-8177762242

(b) Open source software and website address :

1. http://logos.cs.uic.edu/366/notes/ ErrorCorrectionAndDetectionSupplement.pdf
2. https://www.youtube.com/watch?v=N8Yy0-4YMS4
3. Full Subtractor:-http://www.flintgroups.com/2012/10/half-subtractor-and-full-subtractor.html
4. Encoder and Decoder:-http://www.edgefxkits.com/blog/encoders-and-decoders-truth-tables/

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	CRO	50 MHz, Dual Trace, Dul beam, in built +-5v supply, component tester, function generator	LE 17,18
2	Digital multimeter	Digital multimeter 3 and ½ digit with component tester	LE 15,17,18
3	Function generator	0-2 MHz with sine ,square and triangular wave output with variable frequency and amplitude	LE 12,13,14,15,16
4	Power supply	0-24v , 1A	LE 1 to LE 18
5	Logic Analyzer	24 channel	LE 1 to LE 16

N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Use number systems and codes for various applications	3	2	2	2	2	1	1	2	1	1	2	2
CO-2 Test the functionality of various types of logic gates	3	3	3	3	2	1	1	2	1	2	2	2
CO-3 Build and test various types of combinational circuits.	2	3	3	2	1	1	1	2	1	2	3	3
CO-4 Build and test various types of sequential circuits	2	3	3	3	2	1	1	2	1	1	3	3
CO-5 Maintain various types of A/D converters, D/A converters	2	2	3	3	2	1	2	1	1	2	3	3

Legend: 1- Low, 2- Medium, 3- High

O) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-1 Use number systems and codes for various applications	SO1.1 SO1.2 SO1.3 SO1.4	LE1.1 LE1.2 LE1.3	Unit-1 NUMBER SYSTEM and CODES 1.1, 1.2 1.3, 1.4, 1.5	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-2 Test the functionality of various types of logic gates.	SO.2.1 SO.2.2 SO2.3 SO2.4 SO2.5	LE2.1 LE2.2 LE2.3 LE2.4	Unit-2 Logic gates and Boolean algebra 2.1 2.2 2.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-3 Build and test various types of combinational circuits	SO.3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6	LE3.1 LE 3.2 LE3.3 LE3.4 LE3.5	Unit-3 Combinational Circuits 3.1 3.2 3.3 3.4	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-4 Build and test various types of sequential circuits	SO4.1 SO4.2 SO4.3 SO4.4	LE4.1 LE4.2 LE4.3 LE4.4 LE4.5	Unit-4 SEQUENTIAL CIRCUITS 4.1 4.2 4.3 4.4	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-1,2	CO-5 Maintain various types of A/D converters, D/A converters.	SO5.1 SO5.2 SO5.3	LE5.1, LE5.2 LE5.3, LE5.4 LE5.5, LE5.6	Unit-5 CONVERTERS AND LOGIC FAMILIES 5.1 5.2 5.3	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A) Course Code : 2028375(024)

B) Course Title : Basics of Electrical Engineering

C) Pre- requisite Course Code and Title : Physics

D) Rationale :

This course is classified under basic technology group and is intended to enable the students to apply the basic/fundamental concepts of electrical engineering in electrical circuits, principles of Magnetism and electromagnetism in electrical machines. They have to supervise single and three phase ac circuits, trouble shoot transformers, DC, AC and some special purpose machines in their field of applications. The laboratory course fundamentally aims at familiarizing the students with the fundamentals of various electrical circuits and electrical machines and their applications in the electrical and electronics systems.

E) Course Outcomes:

CO-1 Apply basic concepts of Electrical engineering to electric circuits.

CO-2 Apply the concepts of Magnetism and electromagnetism to Electrical machines.

CO-3 Measure various parameters of single and three phase AC circuits.

CO-4 Analyze the working of Transformers and DC Machines

CO-5 Analyze the working of AC and special electrical Machines

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Total Credit L+T+(P/2)
1	Electrical Engineering	2028375(024)	Basics of Electrical Engineering	2	-	1	3
2	Electrical Engineering	2028365(024)	Basics of Electrical Engineering (Lab)	-	2	-	1

Legend: L-Lecture, P- Practical, T- Tutorial

G) Scheme of Assessment:

S.No.	Board of Study	Course Code	Course Title	Scheme of Examination					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical Engineering	2028375(024)	Basics of Electrical Engineering	70	20	30	-	-	120
2	Electrical Engineering	2028365(024)	Basics of Electrical Engineering (Lab)	-	-	-	30	50	80

Legend: ESE- End semester Exam, CT- Class test, TA- Teacher Assessment

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Apply basic concepts of Electrical Engineering to electrical circuits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 1.1. Explain VI characteristics of an ideal and practical voltage and current sources with a neat sketch. SO 1.2. Measure Voltage and Currents in a given Electrical Circuit by applying KCL and KVL. SO 1.3. Measure Voltage and Current in a given Electrical Circuit by applying network Theorems.	LE1.1 Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter. LE1.2 Connect capacitors in series and parallel combination on bread board and measure its value using multimeter. LE1.3 Measure Current and Voltage in series and Parallel Circuits by applying KCL and KVL. LE1.4 Measure Voltage across a source under no load and load conditions. LE1.5 Measure current through and voltage across a load and verify applying Superposition Theorem. LE1.6 Measure Power across the load and verify applying Maximum Power Transfer Theorem.	**Unit-1.0 Basic concepts of Electrical Engineering** 1.1 Basic electrical Concept Concept of Current - D.C./A.C., Concept of voltage- D.C., A.C., E.M.F., Potential difference, Terminal voltage 1.2 Electrical Components: Resistors, inductors and capacitors and their properties 1.3 Voltage and Current sources: Ideal / Practical 1.4 Ohm's law, Kirchhoff's Current and Voltage Law (KCL & KVL) : Series and Parallel circuits, Sta to Delta and Delta to star transformation, Nodal and Loop Analysis 1.5 Network Theorems: Superposition, Maximum Power Transfer Theorem	• Identify the use of resistor, inductor, capacitor in daily use. • Explain the purpose of using Choke in fluorescent lamp. • Explain the use of Capacitor in a Ceiling fan

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. For a given electric circuit apply relevant basic laws/theorems to determine voltage and currents.

ii. Differentiate between the VI characteristics of a ideal and practical voltage and current source.

b. Mini Project:

i. Prepare a chart displaying active and passive elements in electrical engineering laboratories.

ii. Test the choke in a fluorescent lamp for its proper working.

c. Other Activities (Specify):

i. Seminar on Electrical circuits(DC & Ac)

ii. Seminar on Network theorems

CO-2 Apply the concepts of Magnetism and electromagnetism to Electrical machines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Explain the terms used in Magnetism. SO2.2 Explain Faraday's laws of electromagnetic induction with an example. SO2.3 Explain Lenz's law with an example.	LE 2.1. Demonstration of Statically and Dynamically induced emf. LE 2.2. Demonstration of Faraday's laws of electromagnetic induction. LE 2.3. Demonstration of Lenz's law of electromagnetic induction.	**Unit-2.0 Magnetism and Electromagnetism** 2.1 Concepts of Magnetic Circuits, Flux, Magneto Motive Force, Reluctance. 2.2 Concepts of Electromagnetic Induction - Self and mutually induced emf, statically and dynamically induced emf with examples, Faraday's Laws of Electromagnetic Induction, Lenz's Law and its applications	• State the application of Faraday's Law of Electromagnetic induction • State the application of Lenz's Law.

SW-2 Suggested Sessional Work (SW) :

a. Assignments:

i. Develop the analogy between electric and magnetic circuits, series and parallel magnetic circuits.

ii. Prepare a chart to differentiate between useful and leakage flux.

b. Mini Project:

i. Search animations demonstrating Faraday's laws of electromagnetic induction and Lenz's law to learn the concepts electromagnetic induction.

c. Other Activities (Specify):

i. Seminar on Faraday's laws of electromagnetic induction and its applications
ii. Seminar on Lenz's law and its application

CO-3 Measure various parameters of single and three phase AC circuits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Analyze Voltage, current, power, impedance and power factor in R-L-C Circuits. SO3.2 Develop the relationship between line and phase values of current and voltage in a 3 phase star/delta circuits. SO3.3 Measure Power in three phase circuits.	LE 3.1. Measure Voltage, current, power and power factor in a RLC series circuit(with resistive load). LE 3.2. Measure three phase power using two wattmeter method. LE 3.3. Measure three phase power using three wattmeter method.	**Unit-3.0 AC Circuits** 3.1 AC fundamentals- Phase Difference, Power Factor- Unity, Lag and lead RMS Value, Average Value and Form Factor 3.2 Single phase AC circuits RLC Circuits, Impedance and admittance, Power in AC Circuits, Phasor Representation. 3.3 Poly phase circuits Basic Concepts of Three Phase Generation, Relationship between Line and Phase values of voltages and currents 3.4 Power relation in three phase AC circuits, Star and Delta configuration (Balanced load only)	• Measure and Observe the Line and Phase values of Voltage and Current of your institute • Determine the pf in an ac circuit with resistive, inductive and capacitive load.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Collect the Electricity bills at least for 5 months of any one HT consumer and analyze the status of power factor in the bill.
ii. Differentiate between Active, Reactive and Apparent power with examples.

b. Mini Project:

i. Connect three choke in series and 40 watt lamp in series with a switch across a single phase ac supply. Analyze the effect of switching action and comment.
ii. Determine the p.f. and power of a series RL circuit by 3 Ammeter method.
iii. Determine the p.f. and power of a series RL circuit by 3 voltmeter method

c. Other Activities (Specify):

i. Conduct a market survey and prepare the specification of single phase and 3 phase autotransformers.

CO-4 Analyze the working of Transformers and DC Machines

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Describe construction and working principle of transformer. SO4.2 Describe the construction of a DC machine with the help of suitable sketch. SO4.3 Explain working principle of DC Generator and DC Motor.	LE4.1 Measure voltage transformation ratio of a single-phase transformer. LE4.2 Identify the different parts of a DC machine using cut section model. LE4.3 Measure and plot the terminal voltage with respect to field excitation for a DC generator. LE4.4 Measure and plot speed of a DC motor with respect to Load Current	**Unit-4.0 Transformer & DC Machines:**(Restricted to construction and working principle only) 4.1 Transformer - Construction, working principle, Transformation ratio, EMF equation 4.2 DC Machines – Construction 4.3 DC Generator, Types, Working principle. EMF Equation. 4.4 DC Motors, Types, Working principle, emf equation, Back emf, Torque.	• Observe the core and shell type transformer and prepare report on their features. • Observe the series, shunt field winding and armature winding of a DC compound machine and prepare report on their relative resistances.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Prepare a chart of different DC Generators with suitable circuit diagrams.

ii. Prepare a chart of different DC Motors with suitable circuit diagram.

b. Mini Project:

i. Prepare detailed specifications of transformers used at Generating station, transmission and distribution.

ii. Prepare detailed specifications of at least 5 DC motors of different power rating used for different industrial application like rolling mills, Paper mills etc.

c. Other Activities (Specify):

i. Seminar on transformer and its applications

ii. Seminar on DC generators and its applications

iii. Seminar on DC motor and its applications

CO-5 Analyze the working of AC Machines and special electrical machines

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Describe the construction and working principle of three phase induction motor. SO5.2 Describe the construction and working principle of a single phase induction motor. SO5.3 Describe construction of a Synchronous machine. SO5.4 Explain the working of Synchronous machine as Generator and motor SO5.5 Describe the construction and working of a Tachogenerator. SO5.6 Describe the construction and working of Servomotor -Ac & DC. SO5.7 Describe the construction and working of a Brushless DC Motor. SO5.8 Describe the construction and working of a Stepper motor Describe the construction and working of a Universal motor.	LE5.1 Measure the slip of three phase squirrel cage induction motor under varying load. LE5.2 Make connection of starting and running winding and run a single-phase induction motor. LE5.3 Measure voltage generated across an alternator under different loading conditions. LE5.4 Measure the speed of a Synchronous motor for varying load conditions.	**Unit-5.0 AC Machines and Special Electrical Machines** (Strictly rrestricted to construction, types and working principle only) 5.1 Three phase Induction motor Construction and working principles Slip, Torque-Speed Characteristics 5.2 Single phase induction motors- Construction, working principle, types based on starting methods 5.3 Three phase Synchronous machine- Construction, types, Working principle of Synchronous machine as Generator and as a motor 5.4 Special Electrical machines- Construction, working principle, types and applications of a - (i) Tachogenerator (ii) Servomotor-AC & DC (iii) Brushless DC Motor (iv) Stepper motor and (iv) Universal motor	• Compare the efficiency and power factor of a three phase and single-phase induction motor of same rating and prepare report on it. • Compare the rotor construction of a salient and non salient synchronous machine. • Explore the features, working and applications of special electrical machines - Tachogenerator, Servomotor- AC & DC, Brushless DC Motor, Stepper motor and Universal motor.

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. Prepare a chart illustrating the construction, type and applications of a 3 phase induction motor.

ii. Prepare a chart illustrating the construction, type and applications of a single phase induction motor.

iii. Prepare a chart illustrating the construction, types and working of a 3 phase Synchronous machine as generator and motor.

b. Mini Project:

i. Seminar on Special electrical machines - Search internet and download dynamic animations illustrating the construction and working principle of (i) Tachogenerator (ii) Servomotor- Dc & AC(iii)Brushless DC Motor(iv)Stepper motor and (v) Universal motor

c. Other Activities (Specify):

i. Carry out a market survey to find the specifications of 3 phase and single phase induction motor, DC & AC servomotors, Stepper motor, BLDC motor and Universal motor. Prepare a report on commenting on their special features

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table (For ESA of Classroom Instruction):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Basic concepts of Electrical Engineering	4	6	5	15
II	Magnetism and Electromagnetism	4	4	2	10
III	AC Circuits	4	6	5	15
IV	Transformer & DC Machines	4	8	3	15
V	AC Machines and Special Electrical Machines	4	8	3	15
Total		20	32	18	70

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Measure Current and Voltage in series and Parallel Circuits applying KCL and KVL.	15	10	5
LE1.2	Measure Voltage across a source under no load and load conditions.	15	10	5
LE1.3	Measure current through and voltage across a load for a given bilateral circuit and verify applying Superposition theorem.	15	10	5
LE1.4	Measure Power across a load in a given circuit and verify applying Maximum Power Transfer theorem.	15	10	5

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.5	Connect resistors in series and parallel combination on bread board and measure its value using digital multi meter.	15	10	5
LE1.6	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	15	10	5
LE2.1	Demonstrate Statically and Dynamically induced emf.	15	10	5
LE2.2	Demonstrate Faraday's laws of electromagnetic induction.	15	10	5
LE3.1	Measure Voltages, current, power and power factor in a RLC series circuit.	15	10	5
LE3.2	Measure Voltage across a source under no load and load conditions.	15	10	5
LE3.3	Measure three phase power using two wattmeter methods.	15	10	5
LE3.4	Measure three phase power using three wattmeter methods.			
LE3.5	Measure voltage transformation ratio of a single phase transformer	15	10	5
LE4.1	Identify the different parts of a DC machine using cut section model.	15	10	5
LE4.2	Measure armature resistance, shunt and series field winding resistance of a DC Machine	15	10	5
LE4.3	Measure and plot the terminal voltage with respect to field excitation for a DC generator.	15	10	5
LE4.4	Measure and plot speed of a DC motor with respect to Load Current.	15	10	5
LE5.1	Measure the slip of three phase squirrel cage induction motor under varying load.	15	10	5
LE5.2	Make connection of starting and running winding and run a single phase induction motor.	15	10	5
LE5.3	Measure voltage generated across an alternator under different loading conditions.	15	10	5
LE5.4	Measure the speed of a Synchronous motor for varying load conditions.	15	10	5

*Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend: PRA: Process Assessment, PDA: Product Assessment

Note: Only one experiment has to performed at the end semester examination of **30 Marks** as per assessment scheme

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Dynamic animations
5. Group Discussion
6. Industrial visits
7. Industrial Training
8. Field Trips
9. Portfolio Based Learning
10. Role Play
11. Demonstration
12. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
13. Brainstorming
14. Others

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	A Textbook of Electrical Technology Volume I & II	Theraja B.L. & Theraja A.K,	S. Chand and Co. New Delhi	Latest edition
2.	Basic Electrical Engineering	Mittle V.N.	Tata McGraw-Hill, New Delhi	Latest edition
3.	Principles of Electrical engineering	Del Toro, Vincent,	Prentice Hall of India, New Delhi	Latest edition
4.	Circuit Theory : Analysis and Synthesis	Abhijit Chakrabarti	Dhanpat Rai and Company	Latest edition
5.	Electrical Machines	Bhattacharya, S.K.	Tata McGraw-Hill, New Delhi	Latest edition
6.	Principles of Electrical Machines	V.K. Mehta	S. Chand and Co. New Delhi	Latest edition
7.	Electrical Machines	Samarjit Ghosh	Pearson Education India	Latest edition
8.	Electric machines	Asfaq Hussain	Dhanpat Rai Publications,	Latest edition
9.	Electrical Machines	Nagrath & Kothari;	Tata McGraw-Hill, New Delhi	Latest edition
10.	Electrical Machines	P.S. Bimbra	Khanna Publishers	Latest edition

(b) Open source software and website address:

1. DC & AC Circuits:- https://www.youtube.com/watch?v=BcIDRet787k
2. Electrical Machines:- http://www.eeeuniversity.com/2013/07/animation-of-electric-machines.html
3. Transformer:-https://www.youtube.com/watch?v=vh_aCAHThTQ

4. AC /DC Motor and Generator:-https://www.youtube.com/watch?v=4texz0Gn7cw
5. DC Motor & Generator :-https://www.youtube.com/watch?v=LAtPHANEfQo
6. Three phase induction motor: https://www.youtube.com/watch?v=M1Ut_p3S26Q
7. Single phase induction motor: https://www.youtube.com/watch?v=_SpwTmCMXqg
8. Synchronous generator : https://www.youtube.com/watch?v=OOeFhL92vC8
9. Synchronous motor: https://www.youtube.com/watch?v=AvvtvVUz85o
10. AC DC motors: https://www.youtube.com/watch?v=unxTKC01CBQ
11. Brushless DC motor: https://www.youtube.com/watch?v=bCEiOnuODac
12. Stepper motor: https://www.youtube.com/watch?v=hHe4Fc6uuBs
13. Servomotors: https://www.youtube.com/watch?v=SemcSgeL7JE
14. Universal motor: https://www.youtube.com/watch?v=QOa07ZdJgts

(c) Others:

1. Electric Machinery and Transformers, Irving L. Kosovo, Prentice Hall of India, New Delhi
2. Transformers, BHEL Bhopal, Tata McGraw-Hill, New Delhi, Latest edition
3. Electric Machinery, Fitzgerald , A.E., Charles Kingsley, Jr., Stephen D. Umans; McGraw-Hill, New York

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1.	Transformer	1 phase, 1 KVA, 230/115 volts,	LE 4.1 , LE2.1, LE5.1
2.	DC Machine	Cut section model	LE4.1
3.	DC motor	Shunt motor, 3 HP, 220 v	LE4.2, LE4.3
4.	Dc motor coupled with DC generator	DC shunt motor - 5 kW, 1000rpm,220V DC DC shunt generator - 5 kW, , 1000rpm, 220V DC	LE4.2
5.	Three phase Induction Motor with mechanical load arrangement	415 V, 3 HP, Squirrel cage	LE5.1
6.	Single Phase Induction Motor	Capacitor start and capacitor run, 230 v, 60 watt	LE5.2
7.	3 phase alternator coupled with DC shunt motor	3 KVA, 415/230V, 50 Hz 3 Phase 4 Wires 0.8 pF 1500 RPM, separate excitor / self static field excitor DC Shunt Motor 3.7 KW, 220 V DC, 4 Poles, 1500 RPM,	LE5.3
8.	DC Motor coupled with Synchronous Motor	DC Motor 220 V,19 Amps,1500 rpm Synchronous Machine:3.5 KVA,220V,5 Amps, 1500 rpm	LE5.4
9.	Autotransformer	230V - 0-260V,4A or 8A single phase 415V - 0-460V,15A three phase	LE3.1 LE3.2, LE3.3
10.	Ammeter	MI - 0-5/10/20 A MC - 0-2/5/10A	LE3.2, LE2.3 LE1.1, LE4.2,LE4.3
11.	Voltmeter	MI - 0-150/300/600V MC- 150/220V or equivalent	LE3.1,LE3.2,3.3 LE1.1,LE4.2
12.	Wattmeter	0-2.5/5A, 0-150/300V	LE3.1

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
		0-5/10A, 0-150/300V	LE3.2, LE2.3
13.	Tachometer	0-10000 RPM	LE4.2, LE4.3,
14.	Digital Multimeter	Component testing, voltage and current measurement knob	LE1.5,LE1.6
15.	Lamp load/ Loading rheostat	5 kw, 230V	LE4.2
16.	Experiment kit for performing superposition theorem	Experiment kit	LE1.3
17.	Experiment kit for performing Maximum transfer theorem theorem	Experiment kit	LE1.4
18.	Experiment kit to demonstrate statically and dynamically induced emf	Experiment kit	LE2.1
19.	Experiment kit to demonstrate Faraday's laws of electromagnetic induction	Experiment kit	LE2.2
20.	Rheostats	0-50 Ohms,5A - 02 Nos 0-100 Ohms, 5 Amp; -03 Nos 0-300 Ohms, 2 amp - 02 Nos	LE4.2, LE4.3 LE1.1 LE4.2, LE4.3
21.	Bread Board	-	LE1.5, LE1.6
22.	Carbon resistors	Different range	LE1.5
23.	Capacitors	Different range	LE1.6
24.	Pf meter	-	LE3.1

N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Apply basic concepts of electrical engineering to electric circuits.	3	3	3	3	1	1	2	2	3	3	2	2
CO-2 Apply concepts of magnetism and electromagnetism to electrical machines.	3	3	2	2	1	1	2	2	3	3	2	2
CO-3 Measure various parameters of single and three phase ac circuits.	3	3	3	3	2	1	2	2	2	3	3	3
CO-4 Measure various parameters of transformers and DC machines.	3	3	3	3	2	1	2	2	2	3	3	3
CO-5 Analyze working of ac machines and special electrical machines.	3	3	3	3	2	1	2	2	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-1 Apply basic concepts of electrical engineering to electric circuits	SO1.1 SO1.2 SO1.3	LE1.1 LE1.2 LE1.3 LE1.4	Unit-1.0 Basic concepts of Electrical Engineering 1.1, 1.2, 1.3, 1.4,1.5	As mentioned in relevant page numbers
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-2 Apply concepts of magnetism and electromagnetism to electrical machines	SO2.1 SO2.2 SO2.3	LE2.1 LE2.2	Unit-2.0 Magnetism and Electromagnetism 2.1, 2.2	
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-3 Measure various parameters of single and three phase ac circuits	SO3.1 SO3.2 SO3.3	LE3.1 LE3.2 LE3.3	Unit-3.0 AC Circuits 3.1, 3.2, 3.3, 3.4	
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-4 Measure various parameters of transformers and DC machines	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2 LE4.3 LE4.4	Unit-4.0 Transformer & DC Machines 4.1, 4.2, 4.3, 4.4	
PO - 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 PSO – 1, 2	CO-5 Analyze working of ac machines and special electrical machines	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5 SO5.6 SO5.7 SO5.8	LE5.1 LE5.2 LE5.3 LE5.4	Unit-5.0 AC Machines and Special Electrical Machines 5.1, 5.2, 5.3, 5.4	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

Name of program: Diploma in Engineering **Semester: III**
Branch : ET &T **Code: NIL**
Subject : Health, Hygiene & Yoga **Total Tutorial Periods: NIL**
No. Of Periods : 2 Periods/Week

Course Objectives:

1 To provide understanding the importance of health.
2 To provide insight into the hygiene aspect & quality of life.
3 To study the concepts of various medical therapy.
4 To practice the various yogasans.
5 To provide knowledge about common diseases and its cure through yagasans and pranayam.
6 To develop concentration through various methods.

UNIT- I **HEALTH & HYGIENE:** Concept of health, Physical health and mental health and wellbeing and how to achieve these, longevity and how to achieve it, concept and common rules of hygiene, cleanliness and its relation with hygiene; Overeating and underrating, amount of food intake required, intermittent fasting; adequate physical labour, sleep; consumption of junk fast food vs nutritious food; fruits, vegetables cereals and qualities of each of these.

UNIT-II **INTRODUCTORY KNOWLEDGE OF COMMON STREAMS OF MEDICINAL CURE:** History, development, basic concepts, modes of operation of Alopathy, Ayurved, Homoeopathy, Biochemic, Unani, Siddha, Accurpressure, Accupunture, Naturopathy, Yogic and Herbal system of medicines, Introduction of Anatomy and Physiology concerned.

UNIT- III **YOGASANS:** Meaning and concept of Yoga, Yogasans and its mode of operation, How to perform Yogasans, Common Yogasans with their benefits, such as, Padahastasan, Sarvangasan, Dhanurasan, Chakrasan, Bhujangasan, Paschimottasan, Gomukhasan, Mayurasan, Matsyasan, Matsyendrasan, Pawanmuktasan, Vajrasan, Shalabhasan, Sinhasan, Shashankasan, Surya Namaskar, Halasan, Janushirasan, Utshep Mudra.

UNIT-IV **YOGASANS FOR COMMON DISEASES:** From Yogic Materia Medica with symptoms, causes, asans and herbal treatment.

- **Modern silent killers:** High blood pressure, diabetes and cancer, causes and cure; Common health problems due to stomache disorders, such as, indigestion, acidity, dycentry, piles and fissures, artheritis, its causes, prevention and cure.
- **Asans for relaxation:** Shavasan, Makarasan, Matsyakridasan, Shashankasan.
- **Asans to increase memory and blood supply to brain:** Shirsh padasan, Shashankasan.
- **Asans for eye sight:** Tratak, Neti Kriya .
- **Pranayam:** Definition and types: Nadi Shodhan, Bhastrik, Shitakari, Bhramari useful for students.

UNIT-V **CONCENTRATION:** Concentration Of Mind And How To Achieve It. Tratak (त्राटक), Concentration On Breath, Japa (जप), Ajapajap (अजपाजप), Internal silence(अन्तमौनक्र Visualization In Mental Sky (चिदाकाश धारणाक्र Concentration On Point Of Light(ज्योति ध्यानक्र Concentration On Feeling (भाव ध्यानक्रConcentration On Figure (मूर्ड्ड ध्यानक्र

Text Books:

Health, Hygiene & Yoga, Dr P B Deshmukh, Gyan Book Pvt Ltd. New Delhi.

Reference Books:

(1) Yogic Materia Medica
(2) Asan, Pranayam and Bandh