Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Electrical Engineering/ Electrical & Electronics Engineering

Semester – 4th Sem

Scheme of Studies :

S.No	Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1	Electrical & Electronics Engg.	2000451(025)	Digital Electronics	2	-	1	3
2	Electrical Engg.	2000452(025)	AC Machines	2	-	1	3
3	Computer Science & Engineering	2000455(022)	Computer Programming and Basic Networking	3	-	0	3
4	Electrical Engineering	2000454(024)	Electrical Power Generation, Transmission & Distribution	2	-	1	3
5	Electrical Engg / Electrical & Electronics Engg.	2000455(024) / 2000456(025)	Electrical Estimating and Costing* / Analog Electronics**	3	-	0	3
6	Electrical & Electronics Engg.	2000461(025)	Digital Electronics (Lab)	-	2	-	1
7	Electrical Engg.	2000462(024)	AC Machines (Lab)	-	2	-	1
8	Computer Science & Engineering	2000463(022)	Computer Programming and Basic Networking (Lab)	-	2	-	1
9	Electrical Engg.	2000464(024)	Electrical Power Generation, Transmission & Distribution (Lab)	-	2	-	1
10	Electrical Engg. / Electrical & Electronics Engg.	2000465(024) / 2000466(025)	Electrical Workshop Practice-II (Lab*) / Analog Electronics (Lab**)	-	2	-	1
11	-	-	Indian Constitution (Non Credit Subject)	-	2	-	0
Total				**12**	**12**	**03**	**20**
Total				**27**			

Subject applicable for Electrical Branch** *** Subject applicable for Electrical & Electronic Branch**

L- Lecture, **T**- Tutorial, **P**- Practical,

Lecture (L)→ CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)

Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T)→ Includes Sessional work (SW) (assignment, seminar, mini project,etc), Self Learnin (SL)

Note: Summer Internship (Industrial Training) of 4 weeks will be carried out in summer vacation after completion of 4th sem and evaluation will be done in 5th sem.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Electrical Engineering/ Electrical & Electronics Engineering

Semester – 4th Sem

Scheme of Examination:

S. No	Board of Study	Course Code	Course Titles	Scheme of Examination					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical & Electronics Engg.	2000451(025)	Digital Electronics	70	20	30	-	-	120
2	Electrical Engg.	2000452(025)	AC Machines	70	20	30	-	-	120
3	Computer Science & Engineering	2000455(022)	Computer Programming and Basic Networking	70	20	30	-	-	120
4	Electrical Engg. Engineering	2000454(024)	Electrical Power Generation, Transmission & Distribution	70	20	30	-	-	120
5	Electrical Engg / Electrical & Electronics Engg.	2000455(024) / 2000456(025)	Electrical Estimating and Costing* / Analog Electronics**	70	20	30	-	-	120
6	Electrical & Electronics Engg.	2000461(025)	Digital Electronics (Lab)	-	-	-	30	50	80
7	Electrical Engg.	2000462(024)	AC Machines (Lab)	-	-	-	30	50	80
8	Computer Science & engineering	2000463(022)	Computer Programming and Basic Networking (Lab)	-	-	-	30	50	80
9	Electrical Engg.	2000464(024)	Electrical Power Generation, Transmission & Distribution (Lab)	-	-	-	30	50	80
10	Electrical Engg. / Electrical & Electronics Engg.	2000465(024) / 2000466(025)	Electrical Workshop Practice-II (Lab*) / Analog Electronics (Lab**)	-	-	-	30	50	80
11	-	-	Indian Constitution (Non Credit Subject)	-	-	-	-	-	-
Total				**350**	**100**	**150**	**150**	**250**	**1000**

***Subject applicable for Electrical Branch** ** **Subject applicable for Electrical & Electronic Branch**

ESE: End of semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Theory includes Sessional work (SW) and Attendance (ATT), with weightage of 70% and 30 % weightage of total respectively.

ii. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.

Note: Summer Internship (Industrial Training) of 4 weeks will be carried out in summer vacation after completion of 4th semester and evaluation will be done in 5th sem.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Electrical Engineering/Electrical & Electronics Engineering **Semester-IV**

A) Course Code : 2000451(025)

B) Course Title : Digital Electronics

C) Pre-requisite Course Code and Title : Basic Electronics Engineering and Engineering Physics

D) Rationale :

This course is classified under basic technology group intends to enable the student to develop the facts, concepts, principles and procedures of digital techniques and their application used in digital circuits and systems. The practical's in this course fundamentally aims at familiarizing the students with a set of knowledge, skills and attitude for applying digital techniques and their applications in various digital circuits and systems. At the end they should be able to develop a course project using digital integrated circuits.

E) Course Outcomes:

CO-1 Develop the concepts of various number systems and its application in digital design.

CO-2 Demonstrate the use of basic logic gates and Boolean algebra.

CO-3 Interpret the design of basic combinational circuits.

CO-4 Analyze the operation of basic sequential circuits.

CO-5 Use relevant memory devices and data converters in digital electronic systems.

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1.	Electrical & Electronics Engineering	2000451(025)	Digital Electronics	2	-	1	3
2.	Electrical & Electronics Engineering	2000461(025)	Digital Electronics (Lab)	-	2	-	1

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

Lecture (L)→CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)

Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T)→Includes sessional work (SW) (assignment, seminar, mini project etc), Self Learning (SL)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

G) Scheme of Assessment:

S. N.	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical & Electronics Engineering	2000451(025)	Digital Electronics	70	20	30	-	-	120
2	Electrical & Electronics Engineering	2000461(025)	Digital Electronics (Lab)	-	-	-	30	50	80

Legend: **ESE:** End semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Theory includes Sessional work (SW) and Attendance (ATT), with weightage of 70% and 30 % weightage of total respectively.

ii. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.

iii. Minimum two experiment from each unit is mandatory.

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 Develop the concepts of various number systems and its application in digital design.

(Approx. Hrs: L+P+T=18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Compare the given number systems. SO1.2 Perform basic arithmetic operations using the given complement arithmetic. SO1.3 Perform basic arithmetic operations employing the given codes.	LE 1.1 Perform various arithmetic operations using different number systems. LE 1.2 Verify the conversion of number systems using the kits in the lab. LE 1.3 Verify and implement the Gray code to Excess -3 code conversion and vice-versa.	**Unit-1.0 Number System and Codes** 1.1. Comparison of digital and analog systems 1.2. Number Systems: Binary Decimal, Octal and Hexadecimal and their conversions 1.3 Binary Addition Subtraction Multiplication and Division 1.4 1's and 2'scomplement of a number, Basic arithmetic operation using complement method 1.5 Different types of codes: 8421 BCD, Excess-3, Gray codes, ASCII	• List applications of various codes. • Perform simple addition and subtraction operations in Octal and Hexadecimal systems. • Write binary equivalent number for a number in 8421, Excess-3 and Gray Code and vice-versa.

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-1 Suggested Sessional Work (SW):

a. Assignments:

i. Perform the conversion and arithmetic operation between the different types of a given number system.

ii. Perform the arithmetic operations and subtractions using 1's and 2's complement as well as 9's and 10's complement.

iii. Make a report on the applications of Excess-3, Gray code and ASCII code.

b. Mini Project:

i. Develop circuits that will help in understanding the number system conversions.

c. Other Activities (Specify):

i. Calculate R's and (R – 1)'s complement.

CO-2 Demonstrate the use of basic logic gates and Boolean algebra.

(Approx. Hrs: L+P+T =12)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Use basic knowledge of digital logic levels to understand the given logic gates. SO2.2 Develop the given basic gates using NAND/NOR gate as universal gate. SO2.3 Simplify the given expression using Boolean laws and K-map method.	LE 2.1. Use various logic gates and understands their applications. LE 2.2. Verify the Boolean algebra by the kits available in the lab. LE 2.3. Develop skills to build and troubleshoot digital circuits.	**Unit-2.0Logic Gates and Boolean Algebra** 2.1 Boolean algebra: Laws of Boolean algebra and De-Morgan's theorem 2.2 Types of logic gates: AND, OR and NOT. Universal Gates: NAND, NOR, EX-OR and EX-NOR. Truth table, symbol, implementation of basic gate using Universal gate 2.3 Max - term, Min - term, Sum of product (SOP) and Product of Sum(POS) expressions, 2.4 Simplification of Boolean functions using laws and theorems. 2.5 Simplification of Boolean functions using K- map method (up to 4 variables)	• Build simple logic circuits using basic and universal logic gates. • To prepare students to perform the analysis and design of various digital circuits.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Realize AND, OR, NOT operations using NAND, NOR gates.

ii. Apply De-Morgan's theorems related postulates to simplify Boolean expressions (up to three variables).

b. Mini Project:

i. Implement a traffic signal circuit using logic and universal gates.

c. Other Activities (Specify):

i. List the different types of gates along with their IC numbers. Write down the ratings and details of any three different ICs from the data sheet.

CO-3 Interpret the design of basic combinational circuits.

(Approx. Hrs: L+P+T =16)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Build a given combination circuits using basic gates and universal gates. SO3.2 UseIC's related to a given combinationa l circuits.	LE3.1 Design and implement adders and subtractors. LE3.2 Develop skills to apprehend IC 74150 and IC 74139.	**Unit-3.0 Combinational Circuits** 3.1 Half Adder, Full Adder, Half subtractor, Full subtractor, parallel adder and subtractor, BCD adder' 3.2 Magnitude comparator (2 and 3 bit). IC 7485 (Pin diagram and truth table) 3.3 Encoders: 4- Input and 2-Output encoder, Octal to Binary and Binary to BCD Encoder , BCD to binary encoder. Multiplexer: 2 × 1, 4 × 1 and 8 × 1 multiplexer (IC 74151) 3.4 Decoders: 3-Line to 8-Line Decoder, 8-4-2-1 BCD to Decimal Decoder. De-multiplexer: 1 × 2, 1 × 4 and 1 × 8 demultiplexer.	• Analyzethe design of Encoders and decoders. • Implementation of combinational Logic functions using standard ICs. • Draw and explain 3 X 8 decoder.

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-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the working of a serial adder with a block diagram.
ii. Realize full-adder using two Half-adders and an OR – gate and write truth table.

b. Mini Project:

i. Design a full adder with half adders and logic gates.
ii. Designan 8 × 1 Multiplexer with the help of 4 × 1 multiplexers.

c. Other Activities (Specify):

i. Collect information about IC's which can be used as half adder and full adder.

CO-4 Analyze the operation of basic sequential circuits.

(Approx. Hrs: CI+ LI+SW+SL=14)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 4.1 Compare various types of flip flops. SO 4.2 Construct counter using given type of flip-	LE4.1 Design and build registers and counter circuits. LE4.2 Identify different types of flip flops	**Unit-4.0Sequential Circuits** 4.1 Flip Flop - basic flip flop and latch, RS F/F, JK F/F, D F/F, T F/F,	• Implementatio n of sequential circuits using standard ICs. • Implementatio

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
flops. SO 4.3 Use different IC linked with given registers and counters.	and corresponding ICs.	truth table, characteristic table and excitation table 4.2 Race around condition, Master-Slave JK flip flop 4.3 UP-DOWN counter (2 to 3 bit), IC7490 (Pin diagram and truth table) 4.4 Universal Shift Registers, IC 74194 (Pin diagram and truth table)	n of Registers and Counters using standard ICs.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the working of 4 bit shift left and shift right registers with the help of sketch.
ii. Construct level clocked JK flip flop using S-R flip-flop and explain with truth table.
iii. Explain the level clocked D and T flip flops with the help of truth table and circuitdiagram.

b. Mini Project:

i. Implement a Modulo-10 Counter.

c. Other Activities (Specify):

i. List the various types of triggering circuits used in flip flops.

CO-5 Use relevant memory devices anddata converters in digital electronic systems.

(Approx. Hrs: CI+LI+SW+SL = 15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Use relevant memory for various applications. SO5.2 Test data converters for digital applications.	LE5.1 Identify the analog output for a 4-bit binary input using S/H circuit and D/A converter. LE5.2 Simulate a digital circuit using the virtual laboratory software.	**Unit-5.0Convertors and memories** 5.1 Digital to analog converters: weighted resistor,R-2R Ladder network 5.2 Analog to digital converters: Successive approximation, Single and Dual slope converters 5.3 Different types of semiconductor memories: RAM ROM, EEPROM, UVEPROM, Static RAM, Dynamic RAM, Flash ROM and non-volatile RAM	• State the difference between Flash ROM and NV RAM. • Compare Static RAM and Dynamic RAM.

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 Sectional Work (SW):

a. Assignments:

i. Distinguish between EEPROM and UVPROM.
ii. List six types of ROM and RAM ICs.
iii. State the need of A/D and D/A converter.

b. Mini Project:

i. Make a report on the specifications, data sheet, and pin diagram of IC ADC0808.

c. Other Activities (Specify):

i. Collect the information about ROM, PROM, EPROM and EEPROM along with IC details.

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	Number System and Codes	5	5	4	14
II	Logic Gates and Boolean Algebra	5	5	4	14
III	Combinational Circuits	3	5	6	14
IV	Sequential Circuits	3	5	6	14
V	Convertors and memories	3	5	6	14
Total		19	25	26	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	Perform various arithmetic operations using different number systems.	50	40	10
LE1.2	Verify the conversion of number systems using the kits in the lab.	50	40	10
LE 1.3	Verify and implement the Gray code to Excess -3 code conversion and vice-versa.	50	40	10
LE2.1	Use various logic gates and understands their applications.	50	40	10

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE2.2	Verify the Boolean algebra by the kits available in the lab.	50	40	10
LE2.3	Develop skills to build and troubleshoot digital circuits.	50	40	10
LE3.1	Design and implementation of adders and subtractors.	50	40	10
LE3.2	Use IC 74151 and IC 74184	50	40	10
LE4.1	Design and build registers and counter circuits.	50	40	10
LE4.2	Identify different types of flip flops and corresponding ICs.	50	40	10
LE5.1	Identify the analog output analog output for a 4-bit binary input using S/H circuit and D/A converter	50	40	10
LE5.2	Simulate a digital circuit using the virtual laboratory Software.	50	40	10

*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's.

#Experiments marked with it may not be given for ESE. However, viva-voce questions related to '#' may be integrated with other experiments during ESE.

Legend: PRA: Process Assessment, PDA: Product Assessment

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

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

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture Method.
2. Tutorial
3. Group Discussion
4. Industrial visits
5. Industrial Training
6. Field Trips
7. Portfolio Based Learning
8. Demonstration
9. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Fundamentals of Digital Circuits	Kumar, A. Anand	Tata McGraw Hill Education Pvt.Ltd., ISBN: 978-8120352681	Fourth Edition, 2016
2.	Digital Logic and Computer Design	Mano M. Morris	Prentice Hall Publication ISBN: 978-0132129374	Fourth Edition
3.	Digital Electronics: Principles and Integrated Circuits	Maini, A.K.	Wiley India Publications ISBN:978-0470510513	First Edition, 2007
4.	Modern Digital Electronics	Jain ,R.P.	McGraw Hill India , ISBN: 978-0070669116	Fourth Edition, 2012
5.	Digital Electronics Circuits and Systems	Puri, V.K.	McGraw Hill , New Delhi, ISBN:978-0074633175	First Edition, 2017
6.	Digital Electronics	Salivahanan S. and Pravin Kumar S.	Vikas Publishing House ISBN:978-8125939368	Fourth Edition, 2010
7.	Digital Principles and Applications	Malvino, A.P.; Leach, D.P.; Saha G.	McGraw Hill Education, New Delhi, ISBN : 97-89339203405	Eighth Edition, 2015

(b) Open source software and website address:

1. Logisim
2. Xcircuit
3. Scilab
4. NPTEL website and IITs virtual laboratory.
5. Number System and Codes :https://www.youtube.com/watch?v=aW3qCcH6Dao
6. Logic Gates and Boolean algebra: https://www.plymouth.ac.uk/.../PlymouthUniversity_MathsandStats_Boolean _algebra_and_logic_gates.pdf.
7. Combinational Circuits: https://www.seas.upenn.edu /~cit595/ cit595s10/.../ combcircuits.pdf.
8. Sequential Circuits: https://www.youtube.com/watch?v=ibQBb5yEDlQ
9. Memory devices: https:// www.tutorialspoint.com/computer. ../ pdf/ memory_devices.pdf.
10. Analog to Digital Convertors:https://en.wikipedia.org/wiki/Analog-to-digital_converter.https://www.youtube.com/watch?v=hRIVGx-fTKs

(c) Others:

1. Learning Packages
2. BIS standards
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.	Function Generators	Frequency : 2 MHz	LE 5.1 &5.2
2.	Regulated DC Power Supply	Output voltage: 0 to 30 V continuously variable, 2 channels , Output current : 0 to 2 Amps, variable,display : 3 and 1/2 digit LED	LE 3.2,3.3, 4.1, 4.2, 5.1 & 5.2
3.	Cathode Ray Oscilloscope (CRO)	30 MHZ Dual Trace	LE 5.1 &51.2
4.	Digital Multimeter	3 ½ Digit Display	LE 2.1,2.2,2.3, 3.1, 3.2, 3.3,4.1, 4.2, 5.1 & 5.2
5.	Digital Multimeter	4 ½ Digit Display	LE 2.1,2.2,2.3, 3.1, 3.2, 3.3,4.1, 4.2, 5.1 & 5.2
6.	Digital IC Tester	Universal Digital IC tester for TTL, CMOS IC, 230V, 40 pin DIP ZIF socket.	LE 3.2,3.3& 4.2
7.	Linear IC Tester	40 pin DIP ZIF socket, should be able to test a wide range of Analog IC's such as ADC, DAC, Op-amp, 555, Transistor Arrays, Analog Switches, Waveform Generator, Line Drivers, Voltages Regulators, PLL's, VCO, PWM Generator, Sample & Hold, Voltages References, Opto-couplers, Comparators & Voltages Followers ,etc.	LE 3.2,3.3& 4.2
8.	LCD Color Digital Storage oscilloscope	60 MHz, 2 Channel	LE 3.2 & 3.3
9.	Breadboard	Cu thin film base	LE 2.1, 2.2, 2.3, 3.1, 4.1, & 5.1
10.	Soldering Iron	230V, 20 watt	LE 1.1, 1.2, 1.3 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2 &5.1
11.	Digital Electronic Trainer Kit	Digital Electronic Trainer Kit with bread board, Fixed 5v DC power supply, 0 - +15v variable DC power supply,0 to -15v variable DC power supply, logic indicators with ON /OFF micro data switches, LED base logic indicators	LE 1.1, 1.2, 1.3 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 5.1 & 5.2

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 Electrical and Electronic Software	PSO-2 Knowledge of Electrical and Electronics related systems
CO-1 Develop the concepts of various number systems and its application in digital design.	3	2	3	2	1	1	1	1	1	2	3	3
CO-2 Demonstrate the use of basic logic gates and Boolean algebra.	2	3	3	3	1	1	1	3	2	3	2	2
CO-3 Interpret the design of basic combinational circuits.	3	2	3	3	1	1	1	2	1	3	3	3
CO-4 Analyze the operation of basic sequential circuits.	3	3	3	2	1	1	1	2	1	2	2	2
CO-5 Use relevant memory devices and data converters in digital electronic systems.	3	2	3	3	1	1	1	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 Develop the concepts of various number systems and its application in digital design.	SO1.1 SO1.2 SO1.3	LE1.1 LE1.2 LE1.3	Unit-1.0 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 Demonstrate the use of basic logic gates and Boolean algebra	SO2.1 SO2.2 SO2.3	LE2.1 LE2.2 LE2.3	Unit-2.0 Logic Gates & Boolean Algebra 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 Interpret the design of basic combinational circuits.	SO3.1 SO3.2	LE3.1 LE3.2	Unit-3.0 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 Analyze the operation of basic sequential circuits.	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2	Unit-4.0Sequential 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 Use relevant memory devices and data converters in digital electronic systems**.**	SO5.1 SO5.2	LE5.1 LE5.2	Unit-5.0 Convertors and memories 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 : 2000452(024)
B) Course Title : A.C. Machines
C) Pre-requisite Course Code and Title : Applied Physics, DC Machines and Transformers
D) Rationale :

Electrical and Electrical & Electronics engineering diploma holders are expected to apply the principle of electromechanical energy conversion in operating, testing and troubleshooting different types of AC machines including special machines. This course will enable them to develop a set of knowledge, skills and attitude for maintaining various types of AC machines and special electrical machines taking appropriate safety measures. This course fundamentally aims at familiarizing the students with the fundamentals of various AC machines and special electrical machines and their applications.

E) Course Outcomes:

CO-1 Synchronize an alternator with bus bar/another alternator.

CO-2 Use synchronous motor for industrial applications.

CO-3 Test the performance of Three-phase induction motor.

CO-4 Maintain single phase induction motors.

CO-5 Use special electrical machines for different applications.

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1.	Electrical Engineering	2000452(024)	A.C. Machines	2	-	1	3
2.	Electrical Engineering	2000462(024)	A.C. Machines (Lab)	-	2	-	1

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

Lecture (L)→ CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)
Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).
Tutorial (T)→ Includes sessional work (SW) (assignment, seminar, mini project etc), Self Learning (SL)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

G) Scheme of Assessment:

S. N.	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical Engineering	2000452(024)	AC Machines	70	20	30	-	-	120
2	Electrical Engineering	2000462(024)	AC Machines (Lab)	-	-	-	30	50	80

Legend: **ESE:** End semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Theory includes Sessional work (SW) and Attndance (ATT), with weightage of 70% and 30 % weightage of total respectively.
ii. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.
iii. Minimum two experiments from each units is mandatory.

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 Synchronize an alternator with bus bar/another alternator

(Approx. Hrs: CI+ LI = 17)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Explain the working of the given Alternator. SO1.2 Justify the need of turbo and hydro generators SO1.3 Derive EMF equation SO1.4 Determine the voltage regulation of the given alternator by synchronous impedance method SO1.5 Synchronize the given alternator with infinite bus bar or another alternator.	LE1.1 Perform direct load test on alternator to determine voltage regulation. LE1.2 Perform voltage regulation of alternator by synchronous impedance method for Unity, lagging and leading power factor. LE1.3 Synchronize a given alternator with infinite bus bar- By two bright and one dark lamp method and by Synchroscope	**Unit-1.0 Alternators** 1.1 Types and applications 1.2 Construction- Salient and Cylindrical rotor 1.3 Equivalent circuit and phasor diagram 1.4 Voltage equation 1.5 Voltage regulation by synchronous impedance method, Open Circuit, Short Circuit characteristics 1.6 Synchronization and conditions of synchronization 1.7 Synchronization of alternator with bus bar/alternator: two bright and one dark lamp method 1.8 Cooling system of alternator 1.9 Maintenance of given alternators	• OC and SC characteristics • Excitation systems used for the field winding of an alternator. • Latest practice of excitation systems. • Concept of Short Circuit Ratio(SCR) • Ampere turn and ZPF method of finding voltage regulation

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Prepare a chart depicting different winding techniques of poly phase AC rotating machines.
ii. Perform test to determine the Short Circuit Ratio of an alternator and prepare a report to signify its importance.
iii. Justify the statement – "even harmonics are absent in alternators".

b. Mini Project: (Any one)

i. Implement an AVR circuit for a given alternator in the lab.

ii. Investigate the performance of unbalance load on a three phase alternator and prepare a report on it.

c. Other Activities (Specify):

i. Download the catalogue of three phase alternator from websites of reputed manufacturers and submit the report showing the specification details of different manufacturers.
ii. Explore the measures taken to eliminate harmonics in an alternator.

CO-2 Use synchronous motors for industrial applications.

(Approx. Hrs: CI+ LI = 15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Describe the given method(s) of starting synchronous motor SO2.2 Differentiate synchronous and induction motor on the basis of the given criteria. SO2.3 Describe general maintenance procedure of the given 3 phase synchronous motor	LE2.1Test the performance of synchronous motor at different load conditions to see the effect of variation of excitation and pf(V & inverted V curve)	**Unit-2.0 Synchronous Motor** 2.1 Working principle 2.2 Starting methods 2.3 Equivalent circuit and phasor diagram 2.4 Effect of change in excitation and pf- 'V' and inverted 'V' curves 2.5 Applications of Synchronous motor - Synchronous condenser and constant speed 2.6 Hunting and its prevention 2.7 Maintenance of synchronous motors	• Special features of Synchronous motor. • Use of Synchronous motor as a Synchronous condenser. • Differences in construction of synchronous motor and synchronous condenser.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Why synchronous motor is not self-starting? List out the methods to self start the synchronous motor.
ii. Describe different applications of synchronous motor.

b. Mini Project:

i. Implement a speed control method for a given synchronous motor.

c. Other Activities (Specify):

i. Dismantle the given synchronous motor and reassemble it.
ii. Prepare a report on two special features of Synchronous motor.

CO-3 Test the performance of Three-phase induction motor

(Approx. Hrs: CI+ LI+SW+SL = 18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Describe the functions of the different parts of the given types of three phase induction motor. SO3.2 Identify the given Induction machine on the basis of rotor. SO3.3 Explain torque slip characteristics of the given three phase induction motor SO3.4 Explain the given method (s) of controlling the speed of the three phase induction motor. SO3.5 Explain the maintenance procedure of the given 3 phase induction motor	LE3.1 Assemble/Disassemble a given 3 phase Induction motor and identify its various parts LE3.2 Measure the slip of 3-phase Induction motor by using; - Tachometer and - Stroboscopic LE3.3 Perform direct load test on three phase induction motor and draw performance curves. LE3.4 Make connections of DOL starter / star-delta starter / Auto Transformer / Rotor Rheostat starter for respective three phase induction motor LE3.5 Perform speed control of squirrel cage induction motor by: - Changing the supply voltage. - Changing the applied frequency. LE3.6 Perform speed control of slip-ring induction motor by rotor rheostat control. LE3.7 Perform no load and block rotor test to analyze the performance of a 3 phase induction motor	**Unit-3.0 Three Phase Induction Motors** 3.1. Construction, types- Squirrel cage - Single, double cage, Wound rotor 3.2. Working principle, Torque-Slip curve, equivalent circuit and phasor diagram 3.3. Torque equation, Starting, running and condition for the maximum torque (Only expression) 3.4. Necessary of starter and types of starters- DOL, Star delta, Autotransformer type and Rotor resistance starter. 3.5. No load and Blocked rotor test, Losses and efficiency 3.6. Speed control of squirrel cage and slip-ring induction motor 3.7. Maintenance of different types of induction motors	• Change the direction of rotation of a 3 phase induction motor by changing phase sequence • Effect of single phasing on three phase induction motor during running and at the time of the start. • Application of three phase induction motor in industry. • Single phase preventers

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Prepare trouble shooting charts of poly phase induction motor.

b. Mini Project:

i. Develop a DOL and star/delta starter using relay and contactor.

ii. Design the contactor based circuit for speed reversal of three phase induction motor.

iii. Measure slip of 3- Phase slip ring induction motor by using galvanometer.

c. Other Activities (Specify):

i. Survey single phase preventers for protection of three phase induction motor.

CO-4 Maintain single phase induction motor.

(Approx. Hrs: CI+LI = 13)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 4.1 Describe the working of the given single phase induction motor. SO 4.2 Describe the Troubleshooting procedure of the given single phase induction motor. SO 4.3 Describe general maintenance procedure of the given single phase induction motor.	LE4.1 Test ceiling fan motor for its functioning. LE4.2 Perform no load test on single phase induction motor to measure rotational losses. LE4.3 Perform Load test on single phase capacitor type induction motor	**Unit-4.0 Single Phase Induction Motor** 4.1 Construction, working and types based on starting methods: split phase- Resistance Start, Capacitor start, Capacitor start capacitor run, Shaded pole induction motor 4.2 Double revolving field theory – equivalent circuit. 4.3 Speed/ torque characteristics 4.4 Maintenance of different types of single phase motors	• Single phase induction motors used in domestic and industrial applications.

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-4 Suggested Sessional Work (SW):

a. Assignments:

i. Explain why single phase induction motors are not self starting?

ii. Explain the working of the following motors with legible sketch;
a) Split phase motor b) capacitor start motor c) shaded pole motor.

b. Mini Project: (any one)

i. Implement speed reversal of a cooler motor.

ii. Dismantle the given semi automatic washing machine and identify each components and its functionality.

iii. Dismantle the given mixer grinder and identify each components and its functionality.

c. Other Activities (Specify):

i. Make a survey to collect specification of single phase induction motors available in market for different applications

CO-5 Use special electrical machines for different applications

(Approx. Hrs: CI+LI = 12)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Describe the construction, working and applications of the given special motor. SO5.2 Explain the speed torque characteristics of the given special motor.	LE5.1 Perform a test on AC servo motor to plot speed torque characteristics. LE5.2 Demonstrate the working of a simple LIM.	**Unit-5.0 Special electrical machines** **5.1** Construction, working Speed/ torque characteristics (where ever applicable) and applications of Special electrical machines : i. AC servo motor ii. Linear Induction Motor(LIM) iii. Reluctance motor iv. Hysteresis motor v. Ac series/ Universal motor	• Typical applications of various special electrical machines. • Constructional differences between i. a DC and AC series motor ii. Reluctance and Hysteresis Motor

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. Prepare a chart depicting the constructional details of the different special machines.
ii. Prepare a chart depicting the efficiency, power output, weight, maintenance, cost and applications of the different special machines.

b. Mini Project: (any one)

i. Prepare a working model of a LIM using available materials
ii. Prepare a report on full step and half step stepper motors including calculation of step angle

c. Other Activities (Specify):

i. Make a survey to collect the specifications of AC series motor used for different applications.
ii. Prepare a report on difference between ACservo motor and single phase induction motor

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	Alternators	5	5	5	15
II	Synchronous Motor	5	5	5	15
III	Three phase Induction Motors	5	5	5	15
IV	Single phase induction motors	5	5	5	15
V	Special Electrical machines	3	3	4	10
Total		**22**	**23**	**25**	**70**

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

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

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Perform direct load test on alternator to determine voltage regulation	50	40	10
LE1.2	Perform voltage regulation of alternator by synchronous impedance method for Unity, lagging and leading power factor	50	40	10
LE1.3	Synchronize a given alternator with infinity bus bar- By two bright and one dark lamp method and by Synchroscope	50	40	10
LE2.1	Test the performance of synchronous motor at different load conditions to see the effect of variation of excitation and pf((V & inverted V curve)	50	40	10
LE3.1	Assemble/Disassemble a given 3 – Φ Induction motor and identify various parts	50	40	10
LE3.2	Measure the slip of 3-phase Induction motor by using Tachometer and by Stroboscopic method	50	40	10
LE3.3	Perform direct load test on three phase induction motor and draw performance curves.	50	40	10
LE3.4	Make connections of DOL starter / star-delta starter / auto transformer / rotor rheostat starter for appropriate three phase induction motor	50	40	10
LE3.5	Perform speed control of squirrel cage induction motor by: i. By changing the supply voltage. ii. By changing the applied frequency	50	40	10
LE3.6	Perform speed control of slip-ring induction motor by Rotor rheostat control.	50	40	10
LE3.7	Perform no load and block rotor test to analyze the performance of a 3 phase induction motor	50	40	10
LE4.1	Test ceiling fan motor for its functioning	50	40	10
LE4.2	Perform no load a test on single phase induction motor to measure rotational losses.	50	40	10
LE4.3	Perform Load test on single phase capacitor type induction motor	50	40	10
LE5.1	Perform a test on AC servo motor to plot speed torque characteristics.	50	40	10
LE5.2#	Demonstrate the working of a simple LIM.	-	-	-

* 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.

Experiments marked with it may not be given for ESE. However viva-voce questions related to '#', may be integrated with other experiments during ESE.

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. Group Discussion
4. Industrial visits
5. Industrial Training
6. Field Trips
7. Portfolio Based Learning
8. Demonstration
9. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Electrical Technology, Volume – II (AC & DC Machines)	Theraja B.L.	S. Chand and Co. Ltd., New Delhi ISBN:9788121924375	5th or latest Edition, 2014
	Electrical Machinery	Dr. P.S. Bhimbra	Khanna Publications ISBN: 8174091734	7th Edition, 2011
2	Electrical Machines	Bhattacharya S. K.	Tata McGraw Hill Education Pvt. Ltd., New Delhi ISBN:9789332902855	2nd edition or latest,1998
3	Electrical Machines (AC & DC Machines)	Gupta J. B.	S. K. Kataria& Sons, New Delhi, ISBN:9788188458141	4th edition or latest
4	Basic Electrical Engineering (Hindi)	Mehta & Gupta	Dhanpat Rai Publishing Company(P) Ltd., ISBN: 978938437826	9th Edition, 2013
5	Electrical Machines	Kothari, D.P. & Nagrath, I.J.	Tata McGraw Hill Education Pvt. Ltd. New Delhi ISBN:9780070699670	4th edition or latest, 2010
6	Electric Machines	Ashfaq Husain	DhanpatRai & Company, ISBN: 6700000000432	Latest edition 2014
7	Basic Electrical Engineering	Mittle V.N. and Mittal Arvind	Tata McGraw Hill Education Pvt. Ltd. New Delhi ISBN:9780070593572	2nd edition, 2005
8	Electric Machinery	Arthur Eugene Fitzgerald and Charles Kingsley	Tata McGraw Hill Education Publications ISBN13: 9780070530393	, 6 th Edition, 2002
8	Electrical Engineering Fundamentals	Vincent Del Toro	Prentice hall Publications ISBN-13 9780132475525	2nd Edition, 2003

(b) Open source software and website address:

1. www.nptel.com/iitm/
2. www.howstuffworks.com/
3. www.vlab.com/
4. Electrical Machines: http://www.eeeuniversity.com/2013/07/animation-of-electric-machines.html
5. AC /DC Motor and Generator: https://www.youtube.com/watch?v=4texz0Gn7cw
6. DC Motor & Generator : https://www.youtube.com/watch?v=LAtPHANEfQo
7. AC DC motors: https: www.youtube.com/watch?v=unxTKC01CBQ
8. Working of 3 phase Induction Motor: https://www.youtube.com/watch?v=AQqyGNOP_3o
9. Synchronous motor working: https://www.youtube.com/watch?v=oTSi27-FTNg
10. Hunting in synchronous motor: https://www.youtube.com/watch?v=O5P1aANy04o
11. Working of alternator: https://www.youtube.com/watch?v=Ak6Zf-wJpsM
12. Parallel operation of 2 alternators: https://www.youtube.com/watch?v=5t1S8qy9oVk

(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	AC Ammeter	Range (0-5-10-20A), Portable analog MI type as per relevant BIS standard	LE1.1, LE1.2,LE1.3 LE2.1 LE3.1,LE3.2,LE3.3,LE3.5,LE3.6,LE3.7 LE4.1, LE4.2, LE4.3 LE5.1, LE5.2
2	AC Voltmeter	Range (0-75/150/300V), Portable analog MI type as per relevant BIS standard	LE1.1, LE1.2,LE1.3 LE2.1 LE3.1,LE3.2,LE3.3,LE3.5,LE3.6,LE3.7 LE4.1, LE4.2, LE4.3 LE5.1, LE5.2
3	Watt meter	0-10KW	LE1.1, LE1.2,LE1.3 LE2.1 LE3.1,LE3.2,LE3.3,LE3.5,LE3.6,LE3.7 LE4.1, LE4.2, LE4.3 LE5.1, LE5.2
4	3 phase autotransformer	10 KVA, Input: 415V, Output 0-470V	LE1.1, LE1.2,LE1.3 LE2.1 LE3.1,LE3.2,LE3.3,LE3.5,LE3.6,LE3.7 LE5.1, LE5.2
5	Three phase variable Lamp load	10-20 A, 0-10KW	As per requirement
6	Three phase variable inductive load	0-10 Amp	As per requirement
7	Rheostat	(0-500 Ohm, 1.2A); (0-100 Ohm, 5A); (0-50 Ohm, 10A); (0-350 Ohm,1.5A); Nichrome wire wound rheostat on	As per requirement

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
		epoxy resin or class F insulating tube with two fixed and one sliding contact	
8	Three phase induction motor with loading arrangement	5 HP, 440V, 8.0A, 1400 RPM Squirrel cage type with brake drum arrangement	LE3.1, LE3.2, LE3.3, LE3.4, LE3.5, LE3.7
9	Three phase slip ring induction motor with external resistor bank	5 HP, 415V	LE3.6
10	Synchronous motor	3 HP, 415V, 3-phase, 50Hz, 1500 RPM	LE3.1,
11	DC shunt motor -- Alternator set	5HP,220V, 1500 RPM, 18A, Excitation- 220V DC	LE1.1, LE1.2, LE1.3
12	Single phase induction motor	1 HP, 220 V, 50Hz, 1440 RPM Drum brake with spring balances	LE4.1, LE5.2, LE5.3, LE5.4,
13.	AC Servomotor	-	LE5.1

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 Electrical and Electronic Software	PSO-2 Knowledge of Electrical and Electronics related systems
CO-1 Synchronize an alternator with bus bar or with another alternator	3	3	3	3	2	2	2	3	3	3	2	2
CO-2 Use synchronous motor for industrial applications	3	3	3	3	2	2	2	3	3	3	2	2
CO-3 Test the performance of a 3 phase induction motor	3	3	3	3	2	2	2	3	3	3	2	2
CO-4 Maintain different types of single phase induction motor	3	3	3	3	2	2	2	3	3	3	2	2
CO-5 Use special electrical machines for different applications	3	3	3	3	2	2	2	3	3	3	2	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 Synchronize an alternator with bus bar / another alternator.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	LE1.1 LE1.2 LE1.3	Unit-1.0 Alternator 1.1 , 1.2, 1.3, 1.4, 1.5, 1.6,1.7,1.8,1.9	As mentioned in relevant page numbers
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-2 Use synchronous motor for industrial applications.	SO2.1 SO2.2 SO2.3	LE2.1	Unit-2.0 Synchronous Motor 2.1, 2.2, 2.3, 2.4,2.5,2.6,2.7	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-3 Test the performance of Three-phase induction motor.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	LE3.1 LE3.2 LE3.3 LE3.4 LE3.5 LE3.6 LE3.7	Unit-3.0 0 Poly Phase Induction Motors 3.1, 3.2, 3.3, 3.4,3.5,3.6,3.7	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-4 Maintain single phase induction motors.	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2 LE4.3	Unit-4. Single phase induction motor 4.1, 4.2, 4.3, 4.4	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-5 Use special electrical machines for different applications	SO5.1 SO5.2	LE5.1 LE5.2	Unit-5.0 Special electrical machines 5.1	

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 : 2000455(022)

B) Course Title : Computer Programming and Basic Networking

C) Pre- requisite Course Code and Title : Computer Fundamentals and Applications

D) Rationale :

This Course imparts problem solving skills in the students, using a popular structured programming language `C'. The course is crafted to help the students to develop logical ability to identify the best solution for a given computing problem. This will be helpful in developing programs for the scientific, research, business and industrial purposes. It is also important to understand the function of Computer Networks. The required knowledge about hardware and software to establish a network and configure various services over it. The overall objectives of this courseis to develop programming skills and develop necessary abilities in students to establish and make it operational for sharing and accessing resources over network.

E) Course Outcomes

CO-1 Write a 'C' program using algorithm, flowchart and expressions.

CO-2 Develop program in 'C' using conditional and loop control statements.

CO-3 Develop program in 'C' using library functions.

CO-4 Develop program in 'C' using single dimensional array.

CO-5 Install and Configure Computer network and devices.

F) Scheme of Studies:

S.N	Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1	Computer Science & Engineering	2000455(022)	Computer Programming & Basic Networking	2	-	1	3
2	Computer Science & Engineering	2000463(022)	Computer Programming & Basic Networking (Lab)	-	2	-	1

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

Lecture (L)→CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)

Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T)→ Includes sessional work (SW) (assignment, seminar, mini project etc), Self Learning (SL)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

G) Scheme of Assessment:

S. N.	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Computer Science & Engineering	2000455(022)	Computer Programming & Basic Networking	70	20	30	-	-	120
2	Computer Science & Engineering	2000463(022)	Computer Programming & Basic Networking (Lab)	-	-	-	30	50	80

Legend: **ESE:** End semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Theory includes Sessional work (SW) and Attendance (ATT), with weightage of 70% and 30 % weightage of total respectively.

ii. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.

iii. Minimum two experiments from each units is mandatory.

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 Write a 'C' program using algorithm, flowchart and expressions

(Approx.Hrs: CI+ LI=17)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Write algorithm and flowchart for a given problem SO1.2 Differentiate keywords and identifiers. SO1.3 Explain basic structure of 'C' program with example. SO1.4 Explain different types of data types in 'C' language. SO1.5 List various types of operators used in 'C' language.	LE1.1 Write an algorithm and draw a flowchart for addition of two numbers. LE1.2 Write an algorithm and draw a flowchart for calculating simple interest. LE1.3 Develop a program in 'C' to display a simple message using printf() function. LE1.4 Develop a Program in 'C' to find ASCII value of a character using input/output function.	**Unit-1.0 Introduction to 'C ' Programming** 1.1. Program logic development using Algorithm and Flowchart 1.2. Algorithm-Developing and writing algorithm using pseudo Codes 1.3. Flowchart- Definition and Importance of flowchart, Symbols of Flowchart, Flow lines, Terminals, Input/output, Processing, Decision, Connection off-page connectors, Limitation of flowchart 1.4. Basic structure of 'C' Program 1.5. Data Concepts- Character	• Use of algorithm for problem solving • Use of flowchart for problem solving • Evolution of programming structure • Basic data concepts &data types used in 'C'. • Types of expression

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.6 Write a simple 'C' Program demonstrating the given data type conversion SO1.7 Write I/O Statements for the given data		set, C Tokens, Keywords and Identifiers, Constants, variables and its Declaration 1.6. Data Types- data type conversion 1.7. Operators and its types- Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional , Bitwise, Special operators 1.8. Input/Output Functions- printf(), scanf(), getch(), putch(), getchar()	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Differentiate between formatted and unformatted input/output function in 'C'.
ii. Advantages of algorithm and flowchart.
iii. Differentiate between pre increment and post increment with an example.
iv. Differentiate between pre decrement and post decrement with an example.

b. **Mini Project**:

i. Write an algorithm and draw a flowchart to find given number is positive or negative.
ii. Write a program in 'C' to swap two numbers using third variables.
iii. Write a program in 'C' to swap two numbers without using third variables.

c. Other Activities (Specify):

i. A Seminar on -Use of Algorithm and Flowchart in programming.
ii. A seminar on -Data Types, Types of operators and Input/output Functions in 'C' language'.

CO- 2 Develop program in 'C' using conditional and loop control statements.

(Approx.Hrs:CI+ LI=13)

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning(SL)
SO2.1 Describe the syntax of decision making statements with examples in 'C' language.(if, if else, nested if else, else if ladder, switch statements) SO2.2 Apply different Branching statements on a given problem.	LE2.1 Write program for solving quadratic equation using if…else statement in 'C'. LE2.2 Write a program in 'C' to calculate the grade of a student using nested if…else statement in 'C' LE2.3 Write a program in 'C' to Calculate sum of first 'N' natural numbers using while	**Unit-2.0Decision making with Branch statements and Loop statements.** 2.1 Introduction of decision making statements in 'C' 2.2 Decision making with IF statement, Simple IF statement, The IF…. ElSE statement, Nesting of IF…. ElSE statement, The ELSE IF ladder 2.3 The Switch statement 2.4 The? : operator 2.5 GOTO statement 2.6 Introduction, The WHILE	• Conditional branching statements in 'C' language. • Multi-way conditional branching in 'C' language. • Unconditional branching in 'C' language. • Nested loops in 'C' language

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning(SL)
SO2.3 List different types of looping statements in 'C' language with examples. SO2.4 Explain the use of break and continue statements in loops with examples in 'C' language. SO2.5 Perform different loop operation on a given program.	and do…while and for loop. LE2.4 Write a program in 'C' to check a given number is prime or not using loop with break statement. LE2.5 Writes a program in 'C' to find Fibonacci series using for/while/do while loop.	Statement, The DO…WHILE Statement 2.7 The FOR statement, The BREAK and CONTINUE statement	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Differentiate between conditional and unconditional branching in 'C'.
ii. Merits and demerits of multi-way branching statements in 'C'.
iii. Develop a program in 'C' to print even and odd values in a given range.

b. Mini Project:

i. Develop a program in 'C' to convert a given number of days in terms of years, weeks and days.
ii. Develop a program in 'C' to check whether the given alphabet is vowel or not.
iii. Develop a program in 'C' to check whether the given number is palindrome or not.

c. Other Activities (Specify):

i. Seminar on 'Use of switch case statement' in 'C' language.

CO-3 Develop program in 'C' using library functions.

(Approx.Hrs:CI+ LI=12)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)	
SO3.1 Describe library functions with examples SO3.2 Classify different string handling function in 'C' with an example. SO3.3 Apply	LE3.1 Write a program in 'C' to calculate sum of two numbers using user-defined function. LE3.2 Write a program in 'C' using the given Library function.	**Unit-3.0 User-defined Function** 3.1 Concept and need of functions 3.2 Library functions: Math functions, String handling functions, other miscellaneous functions.	• Concept of Procedural oriented programming language • Advantages of library functions	•

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)	
different Library function on a given example.				

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Develop a program to Calculate power of a given number using user-defined function.
ii. Develop a program to calculate a square root of a given number using user-defined function.

b. Mini Project:

i. Develop a program in 'C' to find Greatest Common Divisor of given numbers using function.

c. Other Activities (Specify):

i. A Seminar on 'use of functions in 'C''

CO-4 Develop program in 'C' using single dimensional array.

(Approx.Hrs:CI+ LI=15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Describe declaring and initializing of One-Dimensional Array with example. SO4.2 Apply different operation on Array.	LE4.1 Develop a program in 'C' to display list of values in reverse order LE4.2 Develop a program in 'C' to perform addition of all elements of an one dimensional array	**Unit-4.0Array in 'C'** 4.1 Declaring and initializing One-Dimensional Array. 4.2 Array Operations- 4.2.1 Insertion, 4.2.2 Searching, 4.2.3 deletion, 4.2.4 string operation, 4.2.5Concatenation of two strings.	• Advantages of array

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Describe one dimensional array dimensional arrays in 'C' with examples.
ii. Develop a program in 'C' to search a given number in one dimensional array.

b. Mini Project:

i. Develop a program in 'C' that performs inverse of square matrix.

c. Other Activities (Specify):

i. A seminar on 'use of one dimension of array in 'C' language'.

CO-5 Install and Configure Computer network and devices.

(Approx.Hrs:CI+ LI=18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 List the applications of Computer Networks. SO5.2 Differentiate various line configurations. SO5.3 Design a computer network layout considering particular topology. SO5.4 Categorise computer network based on scope and connection SO5.5 Apply different type of Network Topology. SO5.6 Use of various Network devices. SO5.7 Describe the applications of network devices in different layers.	LE5.1 Establish a network to connect computing systems by using any type of topology. LE5.2 Demonstrate the topology used in computer network. LE5.3 Install, configure and Test Repeaters for networking LE5.4 Install, configure and Test Routers for networking LE5.5 Install, configure and Test Gateway for networking	**Unit-5.0 Computer Networks and devices** 5.1 Definition & history of networks, 5.2 Application of Computer Networks, 5.3 Standard Organizations and Protocols, 5.4 Line Configuration 5.4.1 Point to Point connection, 5.4.2 Multipoint connection, 5.5 Network Topology 5.5.1 Bus Topology, 5.5.2 Ring Topology, 5.5.3 Star Topology, 5.5.4 Hybrid Topology, 5.6 Categories of network 5.6.1 LAN, 5.6.2 WAN, 5.7 OSI model and its main function, feature of each layer. 5.8 TCP/IP model and its main function, feature and protocol of each layer. 5.9 Types of Transmission Media 5.9.1 Twisted Pair, 5.9.2 Coaxial Cable, 5.9.3 Optical Fiber, 5.10 Introduction to Network communication devices 5.10.1 Repeater, 5.10.2 Hub, 5.10.3 Switch, 5.10.4 Bridge, 5.10.5 Router, 5.10.6 Access Point, 5.10.7 Gateway, 5.10.8 RS 232, 5.10.9 RJ 45 &RJ11, 5.10.10 Client Server Architecture.	• Differentiate between point to point and multipoint connection. • Difference between Layer 2 and Layer 3 Switches. • Describe Network Management software

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. Illustrate advantages and disadvantages of different types of network topology.
ii. Identifies different type of topology used in different type of network.
iii. Identify application of physical scope of computer network.
iv. Describe the applications of network devices in different layers

b. Mini Project:

i. Design a small network layout based on LAN in your computer lab.
ii. Identify loss of datagram/ Packet in the Congestion network.

c. Other Activities (Specify):

i. Identify different type of computer network in real life.
ii. Difference between internet and intranet.

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 to Programming in 'C'	5	5	4	14
II	Decision making with Branch statements and Loop statements.	5	5	4	14
III	User-defined Function	3	5	6	14
IV	Array in 'C'	3	5	6	14
V	Computer Networks and devices	3	5	6	14
Total		19	25	26	70

Legend: R: Remember, U: Understand, A: Apply and above
Note: After completion of all the chapters student will be able to perform the list of following experiments:

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

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Write an algorithm and draw a flowchart for addition of two numbers.	50	40	10
LE1.2	Write an algorithm and draw a flowchart for calculating simple interest.	50	40	10
LE 1.3	Develop a program in 'C' to display a simple message using printf() function.	50	40	10
LE 1.4	Develop a Program in 'C' to find ASCII value of a character using input/output function.	50	40	10
LE2.1	Write program for solving quadratic equation using if…else statement in 'C'.	50	40	10

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE2.2	Write a program in 'C' to calculate the grade of a student using nested if…else statement in 'C'	50	40	10
LE2.3	Write a program in 'C' to Calculate sum of first 'N' natural numbers using while and do…while and for loop.	50	40	10
LE 2.4	Write a program in 'C' to check a given number is prime or not using loop with break statement.	50	40	10
LE 2.5	Writes a program in 'C' to find Fibonacci series using for/while/do while loop.	50	40	10
LE3.1	Write a program in 'C' to calculate sum of two numbers using user-defined function.	50	40	10
LE3.2	Write a program in 'C' using the given Library function.	50	40	10
LE4.1	Develop a program in 'C' to display list of values in reverse order	50	40	10
LE4.2	Develop a program in 'C' to perform addition of all elements of an one dimensional array	50	40	10
LE5.1	Establish a network to connect computing systems by using any type of topology.	50	40	10
LE5.2	Demonstrate the topology used in computer network.	50	40	10
LE5.3	Install, configure and Test Repeaters for networking	50	40	10
LE5.4	Install, configure and Test Routers for networking	50	40	10
LE5.5	Install, configure and Test Gateway for networking	50	40	10

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

Legend: PRA: Process Assessment ,PDA: Product Assessment

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	Programming in ANSI C	E. Balaguruswami	Tata McGraw-Hills publication	Latest Edition
2	Programming with ANSI And Turbo C	Ashok N Kamthane	Pearson publication, Latest Edition	Latest Edition
3	Let us 'C'	Yashavant Kanetkar	BPB publications	Latest Edition
4	Computer Networks	Andrew S Tanenbaum	Prentice Hall	-
5	Data communication and Networking	Behrouz, Forouzan,	Mcgraw Hill	2007 or latest
6	Networking Essential – Training Guide	Joe Casad& Dan Newland,	(MCSE, MCT) Tech Media New Delhi	1997 or latest

(b) Open source software and website address:

1. 'C' programming: http://www.programiz.com/c-programming
2. 'C' programming Language: http://www.w3schools.in/c-programming-language/intro/
3. 'C' Language: beginnersbook.com
4. Learn 'C' online:http://www.learnconline.com
5. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf
6. https://doc.lagout.org/network/Data%20Communications%20and%20Networking%20By%20Behrouz%20A.Forouzan.pdf
7. http://www.studytonight.com/computer-network/tcp-ip-reference-model
8. http://www.studytonighty.com/computer-network/network-topology-types

(c) Others:

1. Learning Packages
2. Lab Manuals
3. Users Guide

M) List of Major Laboratory Equipment and Tools:

Computer System with latest configuration and memory

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Computer System	Latest Configuration	LE1.1-LE1.4 ,LE2.1-LE2.5 LE3.1-LE3.2 ,LE4.1-LE4.2, LE5.1-LE5.5
2	'C' compiler	'C' Version (or latest)	LE1.1-LE1.4 , LE2.1-LE2.5 LE3.1-LE3.2 , LE4.1-LE4.2, LE5.1-LE5.5

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 Electrical and Electronic Software	PSO-2 Knowledge of Electrical and Electronics related systems
CO-1 Write a 'C' program using algorithm, flowchart and expressions	2	2	2	1	3	1	1	2	2	3	2	3
CO-2 Develop program in 'C' using conditional and loop control statements.	2	1	2	2	2	1	2	2	1	3	2	3
CO-3 Develop program in 'C' using library functions.	3	2	2	2	1	1	1	3	2	3	3	2
CO-4 Develop program in 'C' using single dimensional array.	2	3	2	2	2	1	2	1	2	1	2	2
CO-5 Explain basics of Computer Networking and devices.	3	3	2	1	3	1	1	2	2	3	2	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 Write a 'C' program using algorithm, flowchart and expressions	SO1.1, SO1.2, SO1.3, SO1.4, SO1.5, SO1.6, SO1.7	LE1.1, LE1.2, LE1.3,LE1.4	Unit 1.0 Introduction to 'C 'Programming. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	As mentioned in relevant page numbers
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-2 Develop program in 'C' using conditional and loop control statements.	SO.2.1,SO2.2, SO2.2, SO2.3 SO2.4,SO2.5	LE2.1, LE2.2, LE2.3, LE2.4, LE2.5	Unit 2.0 Decision making and Branching statements. 2.1,2.2,2.3,2.4,2.5,2.6,2.7	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-3 Develop program in 'C' using library functions.	SO.3.1 SO.3.2	LE3.1 LE3.2	Unit 3.0 User-defined Function 3.1,3.2	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-4 Develop program in 'C' using single dimensional array.	SO.4.1 SO.4.2	LE4.1 LE4.2	Unit 4.0 Array in 'C' 4.1,4.2	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-5 Install and Configure Computer network and devices	SO.5.1, SO.5.2, SO.5.3, SO.5.4 SO.5.5, SO.5.6, SO.5.7	LE5.1 LE5.2 LE5.3 LE5.4 LE5.5	Unit 5.0 Computer Network and devices 5.1,5.2,5.3,5.4,5.5, 5.6,5.7,5.8,5.9.5.10	

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 : 2000454(024)

B) Course Title : Electrical Power Generation, Transmission and Distribution

C) Prerequisite Course Code and Title : Elements of Electrical Engineering, Electrical Circuit, DC Machines and Transformers, AC Machines

D) Rationale :

With growing demand forelectricpoweranddepletingfossilfuelresources,ithasbecomemorenecessary to generate, transmit and distribute electric power more efficiently. With advancement in technology, it has become possible to generate electric power commercially usingwindandsolarenergy.Thiscoursedealsindetailaboutgenerationofelectric power using Thermal, Hydro, Nuclear, and in brief about Solar, Wind, Diesel and other enewal energy sources. Such power plants need highly skilled technicians capable of operating various control equipment to supply uninterrupted power. Equally vital is skills to deal with issues and equipment related to transmission and distribution of electrical power. This course attempts to develop the competency to maintain the various equipment related with electrical power generation, transmission and distribution adopting safety precautions.

E) Course Outcomes:

CO-1 Maintain electrical equipment and related systems in Hydroelectric Power station.

CO-2 Maintain electrical equipment's, related systems in Thermal and Nuclear Power station.

CO-3 Maintain voltage profile of generating stations for various load situations.

CO-4 Maintain power transmission lines.

CO-5 Maintain power Distribution systems.

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1.	Electrical Engineering	2000454(024)	Electrical Power Generation, Transmission and Distribution	2	-	1	3
2.	Electrical Engineering	2000464(024)	Electrical Power Generation, Transmission and Distribution (Lab)	-	2	-	1

L- Lecture, **T**- Tutorial, **P**- Practical,

Lecture (L)→Lecture includes different instructional Strategies i.e Lecture and others.
Practical (P)→Practical includes practical performances in Laboratory workshop, field or other locations using different instructional strategies.
Tutorial (T)→Includes Sessional work (SW) (assignment, seminar, mini project etc), Self Learning (SL)

G) Scheme of Assessment:

Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)					
			Theory			Practical (PRA+PDA+Viva)		Total Marks
			ESE	CT	TA	ESE	TA	
Electrical Engineering	2000454(024)	Electrical Power Generation, Transmission and Distribution	**70**	**20**	**30**	**-**	**-**	**120**
Electrical Engineering	2000464(024)	Electrical Power Generation, Transmission and Distribution (Lab)	**-**	**-**	**-**	**30**	**50**	**80**

ESE: End semester exam CT: Class Test TA: Teachers Assessment
PRA : Process Assessment PDA: Product Assessment

Note:

i. TA in Theory includes Sessional work (SW) and Attendance (ATT) with weightage of 70% and 30% weightage of total respectively.
ii. TA in Practical includes performance of PRA, PDA and Viva-voce with weightage of 50% , 40% and 10% weightage of total respectively.
iii. Minimum two experiments from each unit is mandatory.
iv. Industrial training of 4 weeks duration will be carried out after completion of IV semester and its evaluation will be done in V semester.

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 Maintain electrical equipment and related systems in hydroelectric power plant.

(Approx. Hrs: CI+ LI=14)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Explain with neat sketch the energy conversion process of given hydroelectric power plant. SO1.2 State the criteria for the selection of site for the given hydroelectric power station (HPS) SO1.3 Differentiate the giventypes of hydroturbines.	LE1.1 Demonstrate Hydroelectric Power Plant using an animated model. LE1.2 Draw the line diagram of HPS and main cycles.	**Unit-1.0 Hydroelectric Power Plant** 1.1 Various sources of Electrical Power Generation: Hydro, thermal, nuclear, solar, wind, bio-mass, geo thermal, OTEC, etc. 1.2 Hydroelectric power station (HPS): Energy conversion process, plantlayout. 1.3 Hydrograph and simple calculation of electrical power generation, choice of site and constituents of hydroelectric power plant 1.4 Classification of HPS- based on; - Head	• Explain with neat sketch the energy conversion process of given hydroelectric power plant. • State the criteria for the selection of site for the given hydroelectric power station (HPS) • Differentiate the given

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.4 Classify the hydroelectric power plant based on the given criteria.		- Storage and pondage - Plant layout, types of hydro turbines - Auxiliaries 1.5 Synchronous Generators in HPS: Selection, number of poles, rotor speed and diameter.	types of Hydro Turbines. • Classify the hydroelectric power plant based on the given criteria.

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-1 Suggested Sessional Work (SW):

a. Assignments:

i. Sketch a layout of a typical hydroelectric power plant.

b. Mini Project:

i. Prepare a report on generating capacity of a nearby Hydroelectric Power Stations describing catchment area and head available, power generation capacity and ratings of turbine and generators installed.

c. Other Activities (Specify):

i. Seminar on working Hydroelectric Power Plant using dynamic animation.

CO-2 Maintain electrical equipment and related systems in Thermal and Nuclear Power Station.

(Approx. Hrs: CI+ LI=14)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.1. Explain with neat sketch the energy conversion process of thermal and nuclear power plant. SO 2.2. State the criteria for the site selection of the given power plant. SO 2.3. Explain with neat sketch the working of the given power plants.	LE2.1 Demonstrate the thermal power plant using an animated model. LE2.2 Draw the line diagram of thermal power station and main cycles. LE2.3 Demonstrate nuclear power station using an animated model. LE2.4 Draw the line diagram of nuclear power station and main cycles.	**Unit-2.0 Thermal and Nuclear Power Station** 2.1 Thermal power station: Energy conversion process, plant layout , site selection 2.2 Major equipment and auxiliaries of TPS : Boiler, steam turbine, Turbo Generator, super heater, economizer and electrostatic precipitator, etc) 2.3 NPS: Energy conversion process, Constituents of NPS	• Differentiate between Water tube and Fire tube boiler. • Differentiate between Impulse and Reaction turbine. • List the different Nuclear Fuel used in NPS. • Role of moderators in NPS.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.4. Describe the functions of the given equipment and auxiliaries of aThermal Power Station.		and Layout, Selection of site 2.4 Reactors: Main parts, Types and its Control 2.5 Nuclear Fuels.	

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-2 Suggested Sessional Work (SW):

a. Assignments:

i. Enlist the merits and demerits of Thermal Power Plant over Hydroelectric power plant.
ii. Sketch a layout of a typical Thermal Power Plant.
iii. Sketch a layout of a typical Nuclear Power Plant.

b. Mini Project:

i. Prepare a report on generating capacity of any Thermal Power Plant describing installed capacity of turbine, Generator etc.
ii. Prepare a report on generating capacity of any Nuclear Power Plant describing installed capacity of turbine, Generator etc.

c. Other Activities (Specify):

i. Perform an internet survey about the capacity of power generation through Thermal power plant in CG state (including NTPC and CGSPGCL) and make a presentation.
ii. Prepare an internet survey report about the capacity of power generation through Thermal power plant in India.

CO-3 Maintain voltage profile of generating station for various load situations.

(Approx.Hrs:CI+LI=15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain the given terms related with variable load on power plants ant their importance. SO3.2 Distinguish between load curve and load duration curve of the given power	LE3.1 Prepare a load curve for the complete calendar year of your institution electrical load and analyze it. LE3.2 Prepare a load duration curve for the above data in LE3.1.	**Unit-3.0 Variable Load on Generating Stations** 3.1 Structure of electrical power system. 3.2 Connected load, Maximum demand, average demand, Demand factor, load factor, diversity factor, plant capacity factor and plant use factor and related numerical.	• Restructured/ deregulated power systems

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
generating plants. SO3.3 Differentiate between base load and peak load power plants on the basis of the given criteria. SO3.4 Calculate the cost of electrical energy for the given load.		3.3 Load curve and Load duration curve. 3.4 Base load and peak load on generating stations. 3.5 Relationship between units generated per year, maximum demand and Load factor. 3.6 Cost of electrical energy and related numerical problems.	

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-3 Suggested Sessional Work (SW):

a. Assignments:

i. Draw a load curve for typical loading data collected for a power plant. Draw load duration curve for the data collected.

b. Mini Project:

i. Prepare a report for a typical plant regarding installed capacity, loading, maximum demand etc and determine cost of electricity generated per unit.

c. Other Activities (Specify):

i. Visit of a nearby power plant and collect various related data.

CO-4 Maintain the power transmission lines.

(Approx.Hrs:CI+LI=16)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Determine percentage voltage regulation and transmission efficiency of the given transmission line. SO4.2 Explain the given types of effect related to transmission lines.	LE4.1 Determine Transmission line parameters (R, L, C) using a simulated transmission line model. LE4.2 Determine voltage regulation and power transfer capability of a transmission system using simulated	**Unit-4.0 Transmission Line-Parameters and performance** 4.1 Transmission line parameters: Resistances, inductances and capacitances. 4.2 Skin effect and effect of proximity. 4.3 Stranding and transposition of conductors.	• Recent trends of electrical power transmission in India • Different type of Transmission Towers used inthe industry. • Flexible AC

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.3 Explain the effects of R, L and Con the given transmission line. SO4.4 Explain the features of the given transmission lines. SO4.5 Describe the construction of the given type of insulators.	transmission line model. LE4.3 Determine ABCD parameters of a given transmission line using simulated Transmission line model. LE4.4 Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.	4.4 Classification of transmission lines –Short, medium and long. 4.5 Performance of transmission lines, voltage regulation and efficiency (Only lumped Short and Medium Transmission Line). 4.6 Equivalent circuits, T and π networks, ABCD constants, Ferranti effect, line losses. 4.7 Line insulators: requirements, types, Failure of insulators. 4.8 String efficiency, methods of improving string efficiency (simple numerical)	Transmission Lines. • Extra High Voltage Transmission Lines. • New Trends in wireless transmission of Electrical Power.

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-4 Suggested Sessional Work (SW):

a. Assignments:

i. Prepare a report on power transmission by CSPTCL.

b. Mini Project:

i. Sketch different components of transmission line and explain the purpose of each in detail.

c. Other Activities (Specify):

i. Prepare a report on different type of insulators and conductors used in transmission system with their specifications.

ii. Draw a layout diagram of 11KV/400 V substation in your campus/ adjacent substation.

CO-5 Maintain Power Distribution System.

(Approx.Hrs: CI+ LI=16)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Differentiate the given type of power distribution systems. SO5.2 State the need for given types of	LE5.1 Prepare a report based on survey of the connected loads in your institute premise and find the relevant specifications of different switches,	**Unit-5.0 Distribution System** 5.1 Feeders, distributors and service mains 5.2 Selection of conductor size based on current for distribution systems	(a) Prepare a report on the application of MCB, MCCB, ELCB and ACB as protective device in

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
distribution system. SO5.3 Describe with neat sketches the various connection schemes of the given distribution system. SO5.4 Solve simple numerical problems for the given situation. SO5.5 Identify the given type of cables. SO5.6 Describe the construction of given type of power cables. SO5.7 Explain the fault diagnosing technique in given type of distribution systems.	MCBs and panels and compare it with those already installed. LE5.2 Prepare a report on distribution system of your institute. LE5.3 Test the continuity of power cable.	5.3 Voltage drops in D.C. distributors 5.4 Voltages drop in A.C. distributors. 5.5 Types of underground power cables 5.6 Construction of power cables 5.7 Selection of power Cables for LT and HT connections. 5.8 Laying of underground power cables. 5.9 Faults in Power cables	typical distribution system.

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-4 Suggested Sessional Work (SW):

a. Assignments:

i. Make a load survey of your institution.

b. Mini Project:

i. Visit 11/0.44 kV distribution sub-station and draw line diagram with equipment specifications.

c. Other Activities (Specify):

i. Collect different types of underground cable and arrange them on a display board showing their cross section.

ii. Visit of a nearby power plant and collect various related data like load factor for a complete year.

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	Hydroelectric Power Plant	4	4	4	12
II	Thermal and Nuclear Power Plant	5	5	5	15
III	Variable Load on Generating Stations	4	6	5	15
IV	Transmission Line	4	6	5	15
V	Distribution System	4	5	4	13
	Total	**21**	**26**	**23**	**70**

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

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

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Demonstrate Hydroelectric Power Plant using an animated model.	50	40	10
LE1.2	Draw the line diagram of HPSand main cycles.	50	40	10
LE2.1	Demonstrate the Thermal Power Plant using an animated model.	50	40	10
LE2.2	Draw the line diagram of Thermal Power Station and main cycles.	50	40	10
LE2.3	Demonstrate Nuclear Power Station using an animated model.	50	40	10
LE2.4	Draw the line diagram of Nuclear Power Station and main cycles.	50	40	10
LE3.1	Prepare a load curve for the complete calendar year of your institution electrical load and analyze it.	50	40	10
LE3.2	Prepare a load duration curve for the above data in LE3.1.	50	40	10
LE4.1	Determine Transmission line parameters (R, L, C) using a simulated transmission line model.	50	40	10
LE4.2	Determine voltage regulation and power transfer capability of a transmission system using simulated transmission line model.	50	40	10
LE4.3	Determine ABCD parameters of a given transmission line using simulated Transmission line model.	50	40	10
LE4.4	Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.	50	40	10
LE5.1	Prepare a report based on survey of the connected loads in your institute premise and find the relevant specifications of different switches, MCBs and panels and compare it with those already installed.	50	40	10
LE5.2	Prepare a report on distribution system of your institute.	50	40	10
LE5.3	Test the continuity of power cable.	50	40	10

*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. Demonstration
10. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
11. Brainstorming
12. Others

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Principles of Power System : including generation, transmission, distribution switchgear and protection	V K Mehta Rohit Mehta	S. Chand & Company Pvt. Ltd. , New Delhi ISBN : 978-8121924962	Revised edition, 2015
2.	A course in power systems	J B Gupta	S.K. Kataria& Sons, ISBN: 978-9350143735	2014 edition
3.	Power System Engineering	D.P. Kothari & I.J. Nagrath	McGraw-Hill; ISBN: 978-0070647916	2nd edition, 2008
4.	Transmission and Distribution of Electrical Power	J B Gupta	S.K. Kataria& Sons 978-9350143629	First Edition, 2013
5.	Electrical Power-I	Tarlok Singh	S.K. Kataria& Sons	Latest Edition
6.	A Textbook of Electrical Technology Vol. III	Theraja, B.L.; Theraja, A.K.	S.Chand and Co. New Delhi ISBN : 9788121924900	Latest Edition

(b) Open source software and website address:

1. http://www.nptelvideos.in/2012/11/power-sys-generation-transmission.html
2. http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. www.tpud.org/.../An_Introduction_to_Electric_Power_Transmission_Presentation.pdf
4. www.nct-tech.edu.lk/Download/.../Performance%20of%20Transmission%20Lines..pd.
5. https://www.electrical4u.com/performance-of-transmission-line/
6. https://energy.gov/sites/prod/files/2013/07/f2/Transmission_Woodall_0.pdf

(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.	Transmission line simulator (Short, Medium and Long)	• Single-phase and three-phase lines • Six-section three-phase line • Resistive, inductive and capacitive loads • Over current protection relay Suitable for	LE4.1, LE4.2, LE4.3
2.	Different types of overhead line Insulators	Disc type, pin type, shackle type	LE4.4
3.	Different types of underground cables	LT and HT Cables	LE5.2
4.	Megger	0-1000V, 0.01 kΩ to 1000 kΩ (0 to 1 MΩ on analog scale)	LE4.1

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-1Electrical and Electronic Software	PSO-2Knowledge of Electrical and Electronics related systems
CO-1 Maintain electrical equipment and related systems in Hydroelectric Power station.	2	3	3	3	1	1	2	3	2	3	2	2
CO-2 Maintain electrical equipment and related systems in Thermal and Nuclear Power station.	2	3	3	3	1	1	2	3	2	3	2	2
CO-3 Maintain voltage profile of generating stations for various load situations.	3	3	3	3	1	1	3	3	2	3	2	2
CO-4 Maintain power transmission lines. Transmission line.	3	2	3	2	1	1	2	2	3	3	2	2
CO-5 Maintain power Distribution system.	2	2	2	3	1	1	2	2	2	3	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 Maintain electrical equipment and related systems in Hydroelectric Power station.	SO1.1 SO1.2 SO1.3 SO1.4	LE1.1 LE1.2	Unit-1.0 Hydroelectric Power Plant 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 Maintain electrical equipment and related systems in Thermal and Nuclear Power station.	SO2.1 SO2.2 SO2.3 SO2.4	LE2.1 LE2.2 LE2.3 LE2.4	Unit-2.0 Thermal and Nuclear Power Station 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 Maintain voltage profile of generating stations for various load situations.	SO3.1 SO3.2 SO3.3 SO3.4	LE3.1 LE3.2	Unit-3.0 Variable Load on Generating Stations 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 Maintain power transmission lines.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	LE4.1 LE4.2 LE4.3 LE4.4	Unit-4.0 Transmission Line 4.1, 4.2, 4.3, 4.4,4.5.4.6,4.7,4.8	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-5 Maintain power Distribution system.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5 SO5.6 SO5.7	LE5.1 LE5.2 LE5.3	Unit-5.0 Transmission Line 5.1, 5.2 ,5.3, 5.4,5.5,5.6,5.7,5.8,5.9	

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 : **2000455(024)**

B) Course Title : **Electrical Estimating and Costing**

C) Pre-requisite Course Code and Title : **Elements of Electrical Engineering, Electrical Drawing and CAD**

D) Rationale :

Electrical cabling and wiring plays a major role in transmitting and distributing electrical power from electric utilities to end user. For effective power transmission and distribution to electrical load, installations such as residential, commercial and Industrial, the practicing technician should have a thorough knowledge of the Overhead and underground wiring schemes as per standards. Apart from this he/she should be able to prepare estimates of electrical cabling, wiring and fitting for various installations with a thorough understanding of the standard practices of code of wiring and installations. This course will help diploma pass outs to estimate the cost of electrical wiring, cabling and fitting work etc. required in the field.

E) Course Outcomes:

CO-1 Carryout wiring for different types of Electrical installations and fittings.

CO-2 Use standard practices for estimation and costing of Residential, Commercial and Industrial Electrical installations following IE rules.

CO-3 Prepare detail estimation and costing of Residential, commercial and Industrial Electrical Installation following IE Rules

CO-4 Prepare detail estimate and costing of an Overhead and underground electrical distribution system following IE Rules

CO-5 Prepare estimates for repair and maintenance of electrical equipment and appliances.

F) Scheme of Studies:

S. N.	Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1	Electrical Engineering	2000455(024)	Electrical Estimating and Costing	3	-	0	3

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

Lecture (L)→CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)
Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).
Tutorial (T)→ Includes sessional work (SW) (assignment, seminar, mini project etc), Self Learning (SL)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

G) Scheme of Assessment:

S. N.	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical Engineering	2000455(024)	Electrical Estimating and Costing	70	20	30	-	-	120

Legend: **ESE:** End semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Theory includes Sessional work (SW) and Attendance (ATT), with weightage of 70% and 30 % weightage of total respectively.

ii. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.

iii. Minimum two experiments from each unit are mandatory.

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), 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 Carryout wiring for different types of Electrical installations and fittings.

(Approx.Hrs: CI+ LI=8)

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Select the wiring system for the given type of installations. SO1.2 Interpret the specifications of the given wiring material. SO1.3 Select the material required for wiring of the given electrical installation and fittings. SO1.4 List the applications of given types of wiring tools SO1.5 Identify the given wiring circuit SO1.6 Interpret thegiven IE rules related to wiringand fitting.	LE1.1 Measure the gauge of given wires and validate its current carrying capacity from the given table LE1.2 Prepare the list of material for a given electrical installation. LE1.3 Prepare layout and draw single line wiring diagrams for the given set of machines in a workshop. LE1.4 Undertake wiring work for the given installation and fitting. LE1.5 Prepare list of material for laying the three phase O/H service mains for the given installations	**Unit-1.0 Electrical Wiring** 1.1 Wiring system, Types of wires, 1.2 Specifications of Different types of wiring materials, Accessories 1.3 Selection of material for wiring work. 1.4 Wiring tools. 1.5 Wiring circuits. 1.6 Point wiring system (Short, Medium and Long) 1.7 Service line: single phase, three phase 1.8 Domestic and industrial panel wiring. 1.9 IE Act-2003., I.E. rules for wiring,	• I.E. Rules • Types of Wires • Latest trends in wiring systems • Artificial respiration techniques • LT switchgears • Fire extinguishers

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO1.7 Describe Method of laying of the given service connection observing I.E. rules.			

#LI to be held during class instruction.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Prepare a report on the different type of LT switchgear used in wiring systems.
ii. Survey and prepare a report on the reason for fire accidents in Electrical system.

b. Mini Project:

i. Draw the wiring layout for a residential building having a connected load of 10 kW.
ii. Draw the wiring layout of the one of the laboratory of the institute and also list the materials used in the wiring work as per the layout diagram.

c. Other Activities (Specify):

i. Demonstrate the treatment procedures for an electrocuted person.
ii. Prepare a chart showing specification details of fire extinguishers used for extinguishing fire caused due to electrical faults.

CO-2 Use standard practices for estimation and costing of Residential ,Commercial and Industrial Electrical Installations following IE Rules.

(Approx. Hrs: CI+ LI=10)

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Classify the given types of estimation and estimation tools. SO2.2 Interpret the given schedule of rates SO2.3 Use standard manuals, tables and data books for selection of material SO2.4 Describe the purchase procedure for the given material and quantity. SO2.5 Explain the given types of contracts	LE2.1 Draw the wiring layout and list the material requirement for the given plan of a residential building. LE2.2 Draw the wiring layout and list the material requirement for the given plan of a commercial and industrial installation. LE2.3 Prepare antender notice for the given project work LE2.4 Prepare a sample	**Unit-2.0 Estimating and Costing Practices** 2.1 Estimation and estimation tools. 2.2 Electrical Schedule of rates, catalogues, Survey and source selection, measurement book 2.3 Quantity and cost of material required. 2.4 Purchase system including GeM, Purchase enquiry and selection of purchase mode, Comparative statement, Purchase orders, verification of	• SOR-PWD, CPWD • Market survey for the latest tools and wiring material • Code of practices for wiring and installations

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
and tendering process. SO2.6 Describe the work order issuing procedure for the given work	tender documents for the given work	bills 2.5 Contract system. 2.6 Tendering procedure and preparation of simple tender, Earnest Money, Security Deposit	

#LI to be held during class instruction.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Survey and prepare a chart on the various Electrical tender notices published in Newspaper.

b. Mini Project:

i. Prepare a list of material for installation of an 11/0.415 kV substation with plinth mounted transformer of given rating.

ii. Prepare a report on the rule and procedures to be adopted as per IE Act for execution of Domestic and Industrial Lighting installation.

c. Other Activities (Specify):

i. Prepare a tender report for supply, installation and commissioning of illumination system for the college campus.

CO-3 Prepare detail estimation and costing of domestic, commercial and Industrial Electrical Installation following IE Rules

(Approx. Hrs: CI+ LI=10)

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Calculate the electrical Load of the given domestic premises. SO3.2 Describe the procedure to prepare Layout and wiring diagram for the given domestic premises. SO3.3 Describe the procedure to prepare Layout and wiring diagram for the given commercial and industrial wiring.	LE3.1 Draw layout diagram and wiring scheme for the main distribution and sub distribution for the given premises. LE3.2 Determine the size of a three phase LT power cable required to supply the load of a given domestic premises as per IE rule. LE3.3 Determine the size of main distribution (dimension of box, size of bus bars and rating and number of MCB) box and sub mains for the given load of domestic premises as	**Unit-3.0 Estimation and Costing of residential and industrial wiring** Residential wiring 3.1 Layout 3.2 Load calculation 3.3 Wire, switchgear, Cable and other accessories & fixture/fitting selection 3.4 Earthing system 3.5 Overall Estimating and costing Commercial and industrial Wiring 3.6 Layout 3.7 Load calculation 3.8 Wire, switchgear, Cable and other accessories & fixture/fitting selection 3.9 Earthing system	• Wire, Cable, switchgear, • Earthing system • Wiring materials

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO3.4 Describe the procedure to select suitable wires, switchgears(MCB, Fuses), cables and relevant fitting/fixtures for the given load SO3.5 Describe the procedure for Preparing the bill of material for the given wiring and installations	per IE rule. LE3.4 Prepare an estimate of the material required for the given wiring work. LE3.5 Prepare bill of material for the given wiring and installations	3.10Overall Estimating and costing	

#LI to be held during class instruction.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Survey the market and collect the information about the power cables of different sizes and prepare the report.

b. Mini Project:

i. For a given three phase supply point determine the sizing of underground cable laid at a depth of 500 mm carrying power to a load point of a given capacity, keeping in view of the voltage level at load end as per IE rules.

c. Other Activities (Specify):

i. Draw the wiring layout, BOM and prepare the estimate for the illumination requirement of a given Industrial bay/workshop.

ii. Prepare an estimate of the material required for the earthing requirement of a given Electrical Installation as per IE rules.

CO-4 Prepare detail estimate and costing of an Overhead and underground electrical distribution system following IE Rules.

(Approx. Hrs: CI+ LI=9)

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO4.1 List the material required for the given distribution system SO4.2 Select the relevant material for the given	LE4.1 Draw the freehand sketch of guard used for O/H lines crossing a High way road. LE4.2 Prepare an estimate of the materials required for providing	**Unit-4.0Estimation and costing of Overhead and Underground Distribution System** 4.1 Overhead distribution system. 4.2 Materials and accessories required for the overhead	• Latest trends in overhead and underground distribution system. • Conductors

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
distribution system. SO4.3 Describe the procedure to Prepare plan of the given distribution line project work. SO4.4 Describe the procedure to estimate quantity of material and cost for the given distribution line project work. SO4.5 Describe the procedure to draw layout of the given distribution line. SO4.6 Describe the procedure to estimate quantity of material and cost required for the given distribution project work. SO4.7 Interpret the given I.E. Rules related to distribution system.	Guarding. LE4.3 Draw the single line diagram of plate earthing arrangement LE4.4 Prepare an estimate of the typical plate earthing. LE4.5 Prepare estimate of material required for overhead, 440 V, 3-phase, 4- wire or 3-wire distribution line. LE4.6 Prepare cost estimate of an overhead service connection. (Single phase and three phase) for the given load system. LE4.7 Prepare cost estimate of an underground service connection (single phase and three phase) for the given load profile.	distribution system. 4.3 Distribution lines, Line supports, Factors governing height of pole, 4.4 Conductor materials, size of conductor for overhead line, conductor's configuration, spacing and clearances, span lengths. 4.5 Cross arms, pole brackets, clamps, guys and stays, setting of stays, 4.6 Overhead line insulators, insulator materials, lightning arrestors, erection of supports, 4.7 Earthing of lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between supports conductors, 4.8 I.E. rules pertaining to LV distribution lines 4.9 Estimate for 440 V, 3-phase, 4 wires or 3 wires overhead distribution system. 4.10 Types of service connections 4.11 Method of installation of service connection(1-phase and 3-phase), 4.12 I.E. rules pertaining to overhead lines and service connection 4.13 Underground distribution system. 4.14 Materials and accessories required for underground distribution system. 4.15 Estimate for 440 V, 3-phase, 4 wires or 3 wires underground distribution system. 4.16 I.E. rules pertaining to underground system and service connection.	for overhead distribution line • Power cables for underground and overhead distribution system • Distribution panels

#LI to be held during class instruction.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Draw the free hand sketch and prepare a report of the different O/H line conductors used for distribution lines.

b. Mini Project:

i. Prepare a report on the type, number and size of conductors, insulators , cross arms and other items required for a 11kVOver head distribution line of given length with due consideration of sag as per IE rules.

c. Other Activities (Specify):

i. Reads drawing of electrical installation and calculates quantity of material required for various electric installation and power projects.
ii. Writes specifications and selection of the material required for various electric projects.

CO-5 Prepare estimates for repair and maintenance of electrical equipment and appliances.

(Approx. Hrs: CI+LI= 8)

Session Outcomes (SOs)	Laboratory Instruction (LI)#	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Survey market for cost of the given products and parts. SO5.2 Prepare drawing of the given products SO5.3 Prepare cost table for the given new product SO5.4 Prepare cost table for repair and maintenance of the given appliances and equipment SO5.5 Select tools for the given repairs & maintenance work	LE5.1 Prepare Estimate of the maintenance work of the given electrical product/equipment LE5.2 Prepare Estimate of the maintenance work of the given domestic appliances LE5.3 Prepare tender notices seeking proposal of Annual maintenance contract for the given set of electrical equipment.	**Unit-5.0 Estimation and Costing of Repair and Maintenance of Electrical Equipment and appliances** 5.1 D.O.L. starter, small motor, mono block pump, automatic electric iron, table/ceiling fan, ICDP/ICTP Switch, etc. 5.2 Operating Manuals, service manuals and drawing work of the product/equipment. 5.3 Storage of consumables/ spare parts of the equipment. 5.4 Estimation of repairing cost and overall cost. 5.5 Tools used for repairs & maintenance work 5.6 Preparation of cost schedule for repair and maintenance of; - Electric fan. - Automatic electric iron. - Single phase transformer. - FHP motors - Mixer grinder, D.O.L. Starter.	• Service manuals of products • Maintenance schedule of equipment • Modern electrical measuring and testing tools and their uses

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

#LI to be held during class instruction.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. State the various cost elements involved in electrical installation.

b. Mini Project:

i. Prepare a chart showing the different types of maintenance tools and their approximate market rate.

c. Other Activities (Specify):

i. Survey and collect rates of repair and maintenance work for various electrical equipment/installation.

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	Electrical Wiring	4	4	5	13
II	Estimating and Costing Practices	4	4	5	13
III	Estimating and Costing of Residential and Industrial Wiring	4	4	5	13
IV	Estimation and Costing of Overhead and Underground Distribution System	4	6	8	18
V	Estimation and Costing of Repair and Maintenance of Electrical Equipment	4	4	5	13
Total		**20**	**22**	**28**	**70**

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

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

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Measure the gauge of given wires and validate its current carrying capacity from the given table	50	40	10
LE1.2	Prepare the list of material for a given electrical installation.	50	40	10
LE1.3	Prepare layout and draw single line wiring diagrams for the given set of machines in a workshop.	50	40	10
LE1.4	Undertake wiring work for the given installation and fitting.	50	40	10
LE1.5	Prepare list of material for laying the three phase O/H service mains for the given installations	50	40	10

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE2.1	Draw the wiring layout and list the material requirement for the given plan of a residential building.	50	40	10
LE2.2	Draw the wiring layout and list the material requirement for the given plan of a commercial and industrial installation.	50	40	10
LE2.3	Prepare an tender notice for the given project work	50	40	10
LE2.4	prepare a sample tender documents for the given work	50	40	10
LE3.1	Draw layout diagram and wiring scheme for the main distribution and sub distribution for the given load premises.	50	40	10
LE3.2	Determine the size of a three phase LT power cable required to supply the load of a given domestic premises as per IE rule.	50	40	10
LE3.3	Determine the size of main distribution (dimension of box, size of bus bars and rating and number of MCB) box and sub mains for the given load of domestic premises as per IE rule.	50	40	10
LE3.4	Prepare an estimate of the material required for the given wiring work.	50	40	10
LE3.5	Prepare bill of material for the given wiring and installations	50	40	10
LE4.1	Draw the freehand sketch of guard used for O/H lines crossing a High way road.	50	40	10
LE4.2	Prepare an estimate of the materials required for providing Guarding.	50	40	10
LE4.3	Draw the diagram of plate earthing arrangement	50	40	10
LE4.4	Prepare an estimate of the typical plate earthing.	50	40	10
LE4.5	Prepare estimate of material required for overhead, 440 V, 3-phase, 4- wire or 3- wire distribution line.	50	40	10
LE4.6	Prepare cost estimate of an overhead service connection. (Single phase and three phase) for the given load system.	50	40	10
LE4.7	Prepare cost estimate of an underground service connection (single phase and three phase) for the given load profile.	50	40	10
LE5.1	Prepare Estimate of the maintenance work of the given electrical product/equipment	50	40	10
LE5.2	Prepare Estimate of the maintenance work of the given domestic appliances	50	40	10
LE5.3	Prepare tender notices seeking proposal of Annual maintenance contract for the given set of electrical equipment.	50	40	10

*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 Marksas 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. Demonstration
9. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Electrical costing, estimating and contracting	Bhattacharya, S.K.,	TTTI, Chandigarh	Latest edition
2	I.E. rules		Bharat Manak Sangralaya, Bhopal	Latest edition
3	S.O.R		P.W.D. , CPWD	Latest edition
4	Electrical wiring, estimating and costing	Uppal, S.L., G.C Garg	Khanna Publisher, New Delhi ISBN: 9788174092403	First Edition, 1987
5	Installation, Maintenance and Repair of Electrical Machines and Equipments.	Madhvi Gupta	S.K Kataria and sons ISBN: 978-93-5014-546-3	First Edition,2017
6	Electrical System Design	M.K.Giridharan	I K International Publishing House. ISBN: 978-93-84588-30-7	Second Edition, 2015
7	Electrical Design Estimation and Costing	Raina K B, Bhattacharya S.K	New Age International Publishers ISBN: 9788122403633	Fifth Edition, 2014
8	A Course in Electrical Installation Estimation and Costing	J.B Gupta	S.K. Kataria and Sons ISBN: 9789350142790	2013
9	Electrical Workshop: Safety,Commissioning, Maintenance & Testing of Electrical Equipment.	R.P Singh	I K International Publishing House ISBN: 9789381141295	Third Edition, 2012

(b) Open source software and website address:

1. https://www.youtube.com/watch?v=oV7TpfoiYNY

(c) Others:

1. Learning Packages.
2. Manufacturers' Manual
3. Users' Guide

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1.	Drawing Board		LE1.1-LE5.3
2.	Personnel Computer	Auto cad Electrical software	----do--------

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 Electrical equipment	PSO-2 Electric Power Systems
CO-1 Carryout wiring for different types of Electrical installations and fittings.	2	3	3	3	1	1	2	3	2	3	2	2
CO-2 Use standard practices for estimation and costing of Residential, Commercial and Industrial Electrical installations following IE rules	2	3	3	3	1	1	2	3	2	3	2	2
CO-3 Prepare detail estimation and costing of Residential, commercial and Industrial Electrical Installation following IE Rules	3	3	3	3	1	1	3	3	2	3	2	2
CO-4 Prepare detail estimate and costing of an Overhead and underground electrical distribution system following IE Rules	3	2	3	2	1	1	2	2	3	3	2	2
CO-5 Prepare estimates for repair and maintenance of electrical equipment and appliances.	2	2	2	3	1	1	2	2	2	3	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 Carryout wiring for different types of Electrical installations and fittings.	SO1.1-SO1.7	LE1.1 LE1.2 LE1.3 LE1.4 LE1.5	Unit-1.0 0 Electrical Wiring 1.1 -1.9	As mentioned in relevant page numbers
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO.2 Use standard practices for estimation and costing of Residential, Commercial and Industrial Electrical installations following IE rules.	SO2.1-SO2.6	LE2.1 LE2.2 LE2.3 LE2.4	Unit-2.0 Estimating and Costing Practices 2.1-2.6	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO.3 Prepare detail estimation and costing of Residential, commercial and Industrial Electrical Installation following IE Rules	SO3.1-SO3.5	LE3.1 LE3.2 LE3.3 LE3.4 LE3.5	Unit-3.0 Estimating and Costing of Electrical Installation 3.1-3.10	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO.4 Prepare detail estimate and costing of an Overhead and underground distribution systems following IE Rules	SO4.1-SO4.7	LE4.1 LE4.2 LE4.3 LE4.4 LE4.5 LE4.6 LE4.7	Unit-4.0 Estimation of Overhead Transmission Line and Underground Distribution System 4.1-4.16	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO.5 Prepare estimates for repairs and maintenance of electrical equipment and appliances	SO5.1-SO5.5	LE5.1 LE5.2 LE5.3	Unit-5.0 Estimating and Costing of Repairs and Maintenance of Electrical Equipment 5.1-5.6	

#LI to be held during class instruction.

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 : 2000456(025)
B) Course Title : Analog Electronics
C) Pre- requisite Course Code and Title : Basic Electronics Engineering
D) Rationale :

Analog Electronic components and circuits are the building blocks of any electronic equipment used in industry and consumer electronics products. Therefore the knowledge of basic principles and functions of various analog components and circuits are essential to analyze and maintain various electronic circuits. Laboratory experiences of this course will enable the diploma students to maintain such circuits and systems.

E) Course Outcomes:

CO-1 Test the performance of Operational Amplifier IC.

CO-2 Test the performance of feedback amplifier.

CO-3 Test the performance of various types of oscillators.

CO-4 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.

CO-5 Troubleshoot timer and multi vibrator circuits.

F) Scheme of Studies:

S. N.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1	Electrical & Electronics Engineering	2000456(025)	Analog Electronics	3	-	0	3
2	Electrical & Electronics Engineering	2000466(025)	Analog Electronics (Lab)	-	2	-	1

Legend : **L**- Lecture, **T**- Tutorial, **P**- Practical,
Lecture (L)→CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)
Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).
Tutorial (T)→ Includes sessional work (SW) (assignment, seminar, mini project etc), Self Learning (SL)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

G) Scheme of Assessment:

S. N.	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical & Electronics Engineering	2000456(025)	Analog Electronics	70	20	30	-	-	120
2	Electrical & Electronics Engineering	2000466(025)	Analog Electronics (Lab)	-	-	-	30	50	80

Legend: **ESE:** End semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Theory includes Sessional work (SW) and Attendance (ATT), with weightage of 70%and 30 % weightage of total respectively.

ii. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.

iii. Minimum two experiments from each unit are mandatory.

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.

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CO-1 Test the performance of Operational Amplifier IC.

(Approx. Hrs: CI+LI = 15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Analyze the given OP-AMP specifications. SO1.2 Describe the given characteristics of OP-AMP with example. SO1.3 Describe the functions of the given linear and non-linear OP-AMP circuits. SO1.4 Describe the functions of the given non-linear OP-AMP circuits.	LE1.1 Measure the input offset voltage, input resistance, CMRR, slew rate for a given OP-AMP. LE1.2 Test the performance of OP-AMP inverting amplifier. LE1.3 Test the performance of OP-AMP Non - inverting amplifier. LE1.4 Test the output of scaling amplifier. LE1.5 Test the output of Instrumentation amplifier comprising of OP-AMP. LE1.6 Test the output of Adder and Subtract or circuit comprising of OP-AMP for the given inputs. LE1.7 Test the output of Integrator and differentiator circuit comprising of OP-AMP for the given inputs.	**Unit-1.0 Introduction To Op-Amps** 1.1 Basic differential amplifier, working principle, concept of input current and virtual ground of input terminals of any OP AMP 1.2 OP-AMP 741 IC pin configuration, characteristics, block diagram, specifications 1.3 Electrical parameters-input offset voltage, input resistance, CMRR, slew rate, gain, and bandwidth 1.4 Linear application-inverting and non-inverting amplifiers, OP-AMP as a voltage follower, adder, subtract or, integrator, differentiator. 1.5 Non-linear applications-principle, features and use of OP-AMPs circuits.	• Simulate the various linear OP-AMP applications using any open source software and test the output

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-1 Suggested Sessional Work (SW):

a. Assignments:

i. Analyze the function of integrator and differentiator circuit using OP-AMP.
ii. Compare linear and non linear OP-AMP circuits.
iii. List the various applications of OP-AMP.

b. Mini Project:

i. Develop transistor based OP-AMP circuits that will help in understanding the internal process of OP-AMP and prepare a report.
ii. Build and test the integrator and differentiator OP-AMP circuit and prepare a report

c. Other Activities (Specify):

i. Build and test logarithmic and anti logarithmic amplifier and prepare a report.

CO-2 Test the performance of feedback amplifier.

(Approx. Hrs: CI+LI = 17)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Explain the effect of feedback on amplifier output. SO2.2 Describe the given type of feedback topologies. SO2.3 Explain the effect of negative feedback on the given amplifier parameter. SO2.4 Describe the working of given type of feedback amplifier.	LE2.1 Measure voltage gain and 3-dB frequency of Voltage series feedback transistor amplifier by plotting the frequency response. LE2.2 Measure voltage gain and 3-dB frequency of Voltage shunt feedback transistor amplifier by plotting the frequency response. LE2.3 Measure voltage gain and 3 dB frequency of current series feedback transistor amplifier by plotting the frequency response.	**Unit-2.0Feedback In Amplifiers** 2.1 Concept of feedback: Basic principles, types of feedback, merits and demerits of negative feedback 2.2 Negative feedback in amplifiers, overall gain of negative feedback amplifier, effect of negative feedback on gain, stability, distortion and bandwidth (only physical explanation) 2.3 Voltage series amplifier, voltage shunt amplifier, current series amplifier, current shunt amplifier 2.4 RC coupled amplifiers with emitter by pass capacitor, Emitter follower and its application.	• Compare negative and positive feedback. • Analyze the performance of negative feedback 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-2 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the effect of bypass capacitor on the working of the given type of amplifier.

b. Mini Project:

i. Build and test the performance of RC coupled negative feedback amplifier and prepare a report.

c. Other Activities (Specify):

i. Give a seminar on applications of negative and positive feedback amplifier.

CO-3 Test the performance of various types of oscillators.

(Approx. Hrs: CI+LI = 13)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain the Barkhausen's criteria to start oscillation and Stabilization in the given circuit. SO3.2 Compare working of the given type of sinusoidal oscillators. SO3.3 Describe the working of the given oscillator with neat sketches.	LE3.1 Measure the frequency of oscillation of the given RC phase shift oscillator. LE3.2 Measure the frequency of oscillation of the given we in bridge oscillator. LE3.3 Test the performance of Hartley's oscillator. LE3.4 Test the performance of Colpitt's oscillator. LE3.5 Measure the frequency of oscillation of Crystal controlled Oscillator.	**Unit-3.0 Oscillators** 3.1 Positive feedback in oscillators 3.2 Barkhausen's criteria for oscillation 3.3 Tank circuit: RC phase shift oscillator, Hartley's oscillator circuit, Colpitt's oscillator, Wien Bridge oscillator circuit and Crystal oscillator circuit	• Frequency range of various oscillators • Difference in series and parallel resonance frequency in crystal oscillator.

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-3 Suggested Sessional Work (SW):

a. Assignments:

i. Describe the construction of Crystal Oscillator.

b. Mini Project:

i. Explain the working of different types of RC coupled Oscillators.

c. Other Activities (Specify):

i. Test the effect of biasing on the performance of oscillator.

CO-4 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.

(Approx. Hrs: CI+LI = 16)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain characteristics of the given type of power amplifiers	LE4.1 Measure the efficiency of class A amplifier. LE4.2 Measure the efficiency of class B	**Unit-4.0Power Amplifier** 4.1 Voltage and power amplifier 4.2 Classification of power amplifier ,Working of	• Compare efficiency of various types of power amplifiers.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.2 Define the given parameter of a tuned amplifier. SO4.3 Describe working principle of the given type of tuned amplifier. Compare the efficiency of given type of Power amplifier	amplifier. LE4.3 Measure the efficiency of class B push pull amplifier. LE4.4 Measure the efficiency of class C amplifier.	different types of power amplifier – Class A, B, AB, C and D 4.3 Efficiency of class A and class B amplifier, Efficiency of transformer coupled power amplifier, Efficiency of class B push pull amplifier 4.4 Operation of class B push-pull power amplifier 4.5 Complimentary symmetry push-pull amplifier	• List the various losses in power amplifiers. • List various applications of Power Amplifiers.

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-4 Suggested Sessional Work (SW):

a. Assignments:

i. Compare the efficiencies of different type of Class B Power amplifiers.

b. Mini Project:

i. Build and test a audio power amplifier and DC power amplifier and prepare a report on it.

c. Other Activities (Specify):

i. List at least ten applications of power amplifier.

CO-5 Trouble shoot timer and multi vibrator circuits.

(Approx. Hrs: CI+LI = 14)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Describe the function of the specified pins of IC 555. SO5.2 Select the modes of multi vibrator for the given duty cycle of the waveform. SO5.3 Describe with sketches the procedure to troubleshoot the given wave generation circuit consisting of IC 555.	LE5.1 Test the performance of 555 IC. LE5.2 Determine the duty cycle of an output waveform in 555 timers. LE5.3 Generate square waveform for a given time delay using 555 IC Timer. LE5.4 Test the performance of 555 IC in mono stable mode LE5.5 Test the performance of 555 IC in bi stable mode	**Unit-5.0 Special Application Circuits** 5.1 Timers –Introduction to 555 timer, Pin diagram and functional block diagram of timer, specifications 5.2 Operating modes: Mono stable, Bi-stable and A stable 5.3 Timer 555 as waveform generator: Square, saw tooth and triangle, Pulse width and duty cycle of a pulse signal, Working of a wave generation circuit	• Compare the working of mono stable, Bi-stable and stable modes of 555 timers. • List the applications of various types of multi vibrators.

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. Explain different modes of operation of IC 555 as multi vibrator.

b. Mini Project:

i. Build and test a delay circuit with 50% duty cycle using 555 Timer and prepare a report on it.

c. Other Activities (Specify):

i. Build and test a counter circuit using 555 timers and prepare a report on it.
ii. Build and test a frequency generator circuit using 555 timers and prepare a report on it.

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	
1	Introduction to OP-AMPs	5	4	5	14
2	Feedback in amplifiers	5	5	4	14
3	Oscillators	3	5	6	14
4	Power Amplifier	5	5	4	14
5	Special Applications Circuit	3	5	6	14
Total		21	24	25	70

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

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

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Measure the input offset voltage, input resistance, CMRR, slew rate for a given OP-AMP.	50	40	10
LE1.2	Test the performance of OP-AMP inverting amplifier.	50	40	10
LE1.3	Test the performance of OP-AMP non - inverting amplifier.	50	40	10
LE1.4	Test the output of scaling amplifier.	50	40	10
LE1.5	Test the output of Instrumentation amplifier comprising of OP-AMP.	50	40	10
LE1.6	Test the output of Adder and Subtractor circuit comprising of OP-AMP for the given inputs.	50	40	10
LE1.7	Test the output of Integrator and differentiator circuit comprising of OP-AMP for the given inputs.	50	40	10
LE2.1	Measure voltage gain and 3 dB frequency of Voltage series feedback transistor amplifier by plotting the frequency response.	50	40	10
LE2.2	Measure voltage gain and 3 dB frequency of Voltage shunt feedback transistor amplifier by plotting the frequency response.	50	40	10
LE2.3	Measure voltage gain and 3 dB frequency of current series feedback transistor amplifier by plotting the frequency response.	50	40	10
LE3.1	Measure the frequency of oscillation of the given RC phase shift oscillator.	50	40	10
LE3.2	Measure the frequency of oscillation of the given Wein bridge oscillator.	50	40	10
LE3.3	Test the performance of Hartley's oscillator.	50	40	10
LE3.4	Test the performance of Colpitt's oscillator.	50	40	10
LE3.5	Measure the frequency of oscillation of Crystal controlled Oscillator.	50	40	10
LE4.1	Measure the efficiency of class A amplifier.	50	40	10
LE4.2	Measure the efficiency of class B amplifier.	50	40	10
LE4.3	Measure the efficiency of class B push pull amplifier.	50	40	10
LE4.4	Measure the efficiency of class C amplifier.	50	40	10
LE5.1	Determine the duty cycle of an output waveform in 555 timers.	50	40	10
LE5.2	Generate square waveform for a given time dealy.	50	40	10
LE5.3	Generate square waveform for a given time delay using 555 IC Timer.	50	40	10
LE5.4	Test the performance of 555 IC in mono stable mode.	50	40	10
LE5.5	Test the performance of 555 IC in bi stable mode.	50	40	10

* 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 Method
2. Industrial visits

3. Expert Lecture
4. Field Trips
5. Self Learning
6. Portfolio Based Learning
7. Observation, Practice and Feedback
8. Classroom, Laboratory, Workshop, Field, Video, Live Demonstrations
9. Role Play
10. Charts
11. Demonstration
12. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile) can be integrated with many method

L) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	OP-AMPs and Linear Integrated Circuits	Gayakwad, R. A.	Prentice Hall, ISBN: 978-8120320581	Fourth Edition,2002
2	Linear Integrated Circuits	Choudhury, D. R.; Jain , Shail B.	New Age International Publishers; ISBN:978-9386070913	Fifth edition, 2018
3	Linear Integrated Circuits Analysis, Design, and Applications	Nair, B. S.	Wiley India Pvt. Ltd., New Delhi, ISBN:9788126518968	2009
4	Linear Integrated Circuits	Salivahanan, S.; Bhaskaran, V. S. K.	McGraw-Hill Publishing Company Limited, New Delhi ISBN: 9780070648180	2008
5	Op Amps and Linear Integrated Circuits	Fiore, J. M.	Cengage Delmar Thomson Learning, New Delhi ISBN: 9780766817937	2001
6	Operational Amplifiers and Their Applications	Sarkar, S.	S.Chand Publishing, New DelhiISBN: 9788121917797	2010

(b) List of Open Source Software/learning website:

1. Operational Amplifier Basics : https://www.electronics-tutorials.ws/opamp/opamp_1.html
2. FeedbackAmplifier:https://www.tutorialspoint.com/amplifiers/amplifiers_feedback.htm
3. Oscillators :
   https://www.electrical4u.com/what-is-an-oscillator/
   https://www.youtube.com/watch?v=aJAZHPqEUKU
4. Power Amplifiers:
   https://www.electronicshub.org/power-amplifier/

https://www.tutorialspoint.com/amplifiers/classification_of_power_amplifiers. Htm

5. 555 Timer:
   https://electronicsforu.com/.../learn.../555-timer-working-specifications
6. Multivibrators:
   https://www.elprocus.com/different-types-of-multivibrator-circuits-for-pulse-generation:
   https://www.youtube.com/watch?v=4lFj6h-U6WI

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1.	Regulated DC Power supply	Output voltage: 0 to 30 V continuously variable, 2 channels , Output current : 0 to 2 Amps, variable, display : 3 and 1/2 digit LED	LE1.1,LE1.2,LE1.3,LE1.4,LE1.5,LE1.6,LE1.7,LE3.1,LE3.2,LE3.3,LE3.4,LE3.5,LE4.1,LE4.2,LE4.3,LE4.4,LE5.1,LE5.2
2.	Bread Board	Cu thin film base	LE1.1, LE1.2, LE1.3,LE1.6, LE5.1,LE5.2,LE5.3,LE5.4,LE5.5
3.	Digital Storage Oscilloscopes	30 MHZ Dual Trace	LE1.2,LE1.3,LE1.4,LE1.5,LE1.7,LE2.1,LE2.2,LE2.3,LE3.1,LE3.2,LE3.5,LE4.1,LE4.2,LE4.3,LE4.4,LE5.2,LE5.3
4.	Digital Multi Meter	4 ½ Digit Display	LE1.1,LE1.4,LE1.5,LE1.6,LE1.7,LE2.1,LE2.2,LE2.3,LE3.3,LE3.4,LE4.1,LE4.2,LE4.3,LE4.4.
5.	Function generator	0.5 Hz - 3 MHz with 5 digit LED display, Max. resolution 0.001 Hz, Sine, Square, Triangle, Ramp, Positive Pulse and Negative Pulse	LE1.2,LE1.3,LE1.4,LE1.5,LE1.7,LE2.1,LE2.2,LE2.3,LE3.1,LE3.2,LE3.5,LE4.1,LE4.2,LE4.3,LE4.4,LE5.2,LE5.3

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 Electrical and Electronic Software	PSO-2 Knowledge of Electrical and Electronics related systems
CO-1 Test the performance of Operational Amplifier IC	3	3	3	2	1	1	1	2	2	3	3	2
CO-2 Test the performance of feedback amplifier.	3	2	3	3	1	1	1	3	2	2	3	2
CO-3 Test the performance of various types of oscillators.	3	2	2	2	1	1	1	3	2	3	2	2
CO-4 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.	3	2	3	3	1	1	1	3	2	3	3	2
CO-5 Troubleshoot timer and multi vibrator circuits.	3	3	3	2	1	1	1	2	2	3	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 Test the performance of Operational Amplifier IC.	SO1.1 SO1.2 SO1.3 SO1.4	LE1.1,LE1.2 LE1.3,LE1.4 LE1.5,LE1.6 LE1.7	Unit-1.0 Introduction to Op-Amps 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 performance of feedback amplifier.	SO2.1 SO2.2 SO2.3 SO2.4	LE2.1,LE2.2 LE2.3	Unit-2.0Feedback in Amplifiers 2.1, 2.2,2.3,2.4	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-3 Test the performance of various types of oscillators.	SO3.1 SO3.2 SO3.3	LE3.1,LE3.2 LE3.3,LE3.4 LE3.5	Unit-3.0 Oscillators 3.1, 3.2, 3.3	
PO-1,2,3,4,5,6 7,8,9,10 PSO-1,2	CO-4 Maintain power amplifiers and tuned amplifiers used in various electronics circuits.	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2 LE4.3 LE4.4	Unit-4.0 Power Amplifier 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 Troubleshoot timer and multi vibrator circuits.	SO5.1 SO5.2 SO5.3	LE5.1 LE5.2 LE5.3 LE5.4 LE5.5	Unit-5.0 Special Application Circuits 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 : 2000465(024)
B) Course Title : Electrical Workshop Practice – II (Lab)
C) Pre- requisite Course Code and Title : Electrical Circuit, Basic Electronics, Electrical Workshop Practice-I
D) Rationale :

Electrical diploma holders are expected to identify the parts, control circuits of various domestic appliances, and handle various electrical wiring tools and measuring instruments used for maintaining home appliances. They have to diagnose, troubleshoot and replace faulty components to maintain appliances and equipment's. The course will also develop skills in handling necessary tools required for dismantling and assembly of motors at Electrical workshop.

E) Course Outcomes:

CO-1 Identify and test passive and active electronics components

CO-2 Identify various functional blocks/major components in home appliances

CO-3 Use reference manuals to troubleshoot faults for a given home appliance

CO-4 Maintain AC motor starter panels

CO-5 Practice dismantling and assembly of a given rotating electrical machine

F) Scheme of Studies:

S.No.	Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)			
				L	P	T	Credit L+T+(P/2)
1.	Electrical Engineering	2000465(024)	Electrical Workshop Practice-II (Lab)	-	2	-	1

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

Lecture (L)→CL Classroom Instruction (Includes different instructional Strategies i.e Lecture and others.)
Practical (P)→LI Laboratory Instruction (Includes practical performances in Laboratory workshop, field or other locations using different instructional strategies).
Tutorial (T)→ Includes sessional work (SW) (assignment)

Note: SW has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Note: **The minimum number of Laboratory Instruction (LI) to be performed in the semester is ten, with at least two laboratory instructions to be performed from each Course outcome (CO)**

G) Scheme of Assessment:

S.No	Board of Study	Course Code	Course Title	Scheme of Examination					
				Theory			Practical (PRA+PDA+Viva)		Total Marks
				ESE	CT	TA	ESE	TA	
1	Electrical Engineering		Electrical Workshop Practice-II (Lab)	-	-	-	30	50	80

Legend: **ESE:** End semester exam **CT:** Class Test **TA:** Teachers Assessment

PRA: Process Assessment, **PDA:** Product Assessment

Note: i. TA in Practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10 % weightage of total respectively.

H) Course-Curriculum Detailing:

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

CO- 1 Identify and test passive and active electronics components.

(Approx. Hrs: LI+SW =4)

Session Outcomes (SOs)	Laboratory Instruction (LI)
SO1.1 Select resistors and verify its calculated value by measuring it SO1.2 Select inductors and its application in consumer electronics. SO1.3 Select suitable capacitors for a given application. SO1.4 Describe the use of diode for rectification of AC supply SO1.5 List the application of transistors	LE1.1 Identify the different types of resistors and measure the resistor values LE1.2 Identify different types of inductors. specifications and measure the values using LCR meter LE1.3 Identify different types of capacitors, specifications and measure the values using LCR meter LE1.4 Identify different type of control transformers and measure their primary and secondary voltage. LE1.5 Identify different type of diodes and transistors used in consumer electronics LE1.6 Construct and test a half wave rectifier circuit. LE1.7 Construct and test a switching circuit using transistor

Legend: LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies)

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Check the cold continuity, identify loose/dry solder and broken track on printed circuit board and repair the defective solder joints.

ii. Prepare a report on the control and functional switches in a DSO, Measure the D.C. & A.C. voltage, frequency, time period and store the voltage waveforms.

iii. Construct and test a circuit using photo transistor.

CO-2 Identify various functional blocks/major components in home appliances

(Approx. Hrs.: LI+SW =8)

Session Outcomes (SOs)	Laboratory Instruction (LI)
SO2.1 Understand the functionality of various components of various home appliances SO2.2 Understand the nature of signals observed at test points of various home appliances. SO2.3 Select appliances for a given application	LE2.1 Identify various digital IC's and test it using digital IC tester. LE2.2 Dismantle, identify the various parts and trace the control circuit of a given Electrical mixer/Grinder. LE2.3 Dismantle a home emergency light and identify its major parts. LE2.4 Identify the internal and external components of a given washing machine and operate it. LE2.5 Identify the internal and external components of a given home UPS, install and operate it.

Legend: LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SW: Sessional wok,

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Identify various components of Electric kettle, controls and trace the circuit.
ii. Dismantle the given SMPS and find the IC components.
iii. Identify the internal and external components of a micro wave oven and operate it
iv. Construct a fixed voltage regulator using 78xx/79xx series ICs.

CO-3 Use reference manuals to troubleshoot faults for a given home appliance

(Approx. Hrs.: LI+SW = 8)

Session Outcomes (SOs)	Laboratory Instruction (LI)
SO3.1 Understand the power and control circuit of a given Emergency lamp. SO3.2 Understand the testing procedures for identifying fault ofa given faulty home appliance. SO3.3 Understand the installation procedures of various home appliances	LE3.1 Diagnose the fault of a given faulty Emergency lamp and repair it LE3.2 Use tools and instrument for diagnosing the fault of a given geyser. LE3.3 Diagnose the fault of a given faulty water purifier and replace the faulty component. LE3.4 Diagnose the fault of a mixer grinder, replace the faulty component and operate it

Legend: LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SW: Sessional wok

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Measure the voltage and observe the signal waveform of a given SMPS unit
ii. Monitor, measure major test points and Test the capacity of the given home UPS and rectify the fault.
iii. Connect the inverter to back up the power supply.

CO-4 Maintain AC motor starter panels

(Approx. Hrs: LI+SW =6)

Session Outcomes (SOs)	Laboratory Instruction (LI)
SO4.1 List the various components present in a single-phase motor starter panel SO4.2 List the various components present in a Star/Delta starter panel. SO4.3 Describe the functionality of the different component present in a DOL starter panel. SO4.4 Understand the control schemes and trouble shoot the given AC motor starter panel.	LE4.1 Identify the various components of a starter panel for a given single phase submersible pump LE4.2 Construct the DOL starter with Main Switch and indication lamps for starting a given three-phase motor LE4.3 Identify the faulty component of a given DOL starter panel and repair it. LE4.4 Identify the various components of a starter panel for starting a given three phase

Session Outcomes (SOs)	Laboratory Instruction (LI)
	synchronous motor LE4.5 Identify the faulty component of a given faulty synchronous motor starter panel LE4.6 Construct the Star/Delta starter with Main Switch and indication lamps for starting a given three-phase motor

Legend: LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SW: Sessional work

SW-4 Suggested Sessional Work (SW):

Assignments:

i. Construct a control panel for forward /reverse operation of a given AC motor.
ii. Prepare a chart showing the control schematic for speed control of a three-phase slip ring induction motor.
iii. Visit the nearest water treatment plant and prepare a chart showing the specification details of the various power and control component present in the control panel of an agitator motor.

CO-5 Practice dismantling and assembly of a given rotating electrical machine

(Approx. Hrs: LI+SW =6)

Session Outcomes (SOs)	Laboratory Instruction (LI)
SO5.1 List the various parts of a DC machine. SO5.2 List the tools and tackles required for dismantling a rotating electrical machine. SO5.3 Describe the function of various parts of a DC machine. SO5.4 List the various parts of a three-phase induction motor SO5.5 Describe the function of various parts of a single-phase AC motor.	LE5.1 Identify terminals, parts and connections of a given DC machine LE5.2 Practice maintenance of carbon brushes, brush holders, commutator and sliprings LE5.3 Practice dismantling and assembling of a given DC machine LE5.4 Identify parts and terminals of three phase AC motors LE5.5 Practice dismantling and assembling of a given three phase Induction motor LE5.6 Practice maintenance service and repair of AC single phase motor.

Legend: LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Sessional work

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. Collect information about the need of growler for testing DC machine.
ii. Prepare a chart to show the test procedures for continuity and insulation resistance of three phase induction motor
iii. Identify the parts and terminal of three phase alternator.

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

I) Suggested Specification Table (For Assessment of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (%Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Identify types of resistors and measure their values	50	40	10
LE1.2	Identify types of inductors. specifications and measure their values	50	40	10
LE1.3	Identify types of capacitors, specifications and measure their values	50	40	10
LE 1.4	Identify different type of control transformers and measure their primary and secondary voltage	50	40	10
LE 1.5	Identify different type of diodes and transistors used in consumer electronics	50	40	10
LE 1.6	Construct and test a half wave rectifier circuit.	50	40	10
LE1.7	Construct and test a switching circuit using transistor	50	40	10
LE2.1	Identify various digital IC's and test it using digital IC tester	50	40	10
LE2.2	Identify the various parts and trace the control circuit of a given Electrical mixer/Grinder	50	40	10
LE2.3	Dismantle a home emergency light and identify its major parts	50	40	10
LE2.4	Identify the internal and external components of a given washing machine and operate it	50	40	10
LE2.5	Identify the internal and external components of a given home UPS, install and operate it	50	40	10
LE3.1	Diagnose and repair the fault of a given faulty Emergency lamp	50	40	10
LE3.2	Use tools and instrument for diagnosing the fault of a given geyser	50	40	10
LE3.3	Diagnose the fault of a mixer grinder, replace the faulty component and operate it	50	40	10
LE3.4	Diagnose the fault of a faulty water purifier and replace the faulty component	50	40	10
LE4.1	Identify the various components of a starter panel for a single phase submersible pump	50	40	10
LE4.2	Construct the DOL starter with Main Switch and indication lamps for a three-phase motor	50	40	10
LE4.3	Identify and repair the faulty component of a given DOL starter panel	50	40	10
LE 4.4	Identify the various components of a starter panel for starting a given three phase synchronous motor	50	40	10
LE 4.5	Identify the faulty component of a given faulty synchronous motor starter panel	50	40	10
LE4.6	Construct the Star/Delta starter with Main Switch and indication lamps for starting a given three-phase motor	50	40	10
LE5.1	Identify terminals, parts and connections of a given DC machine	50	40	10
LE5.2	Practice maintenance of carbon brushes, brush holders, commutator and sliprings	50	40	10

LE5.3	Practice dismantling and assembling of a given DC machine	50	40	10
LE5.4	Identify parts and terminals of three phase AC motors	50	40	10
LE5.5	Practice dismantling and assembling of a given three phase Induction motor	50	40	10
LE5.6	Practice maintenance service and repair of AC single phase motor	50	40	10

*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's

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

J) Suggested Instructional/Implementation Strategies:

1. Industrial visits
2. Expert Lecture
3. Field Trips
4. Self-Learning
5. Observation, Practice and Feedback
6. Laboratory, Workshop, Field, Video, Live Demonstrations
7. Charts
8. Demonstration
9. ICT Based Teaching

L) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author	Publisher	Edition & Year
1.	Handbook of Electrical Engineering	Bhatia, S.L.	Khanna Publication	2012
2.	Electronic Components Handbook	Jones, Thomas H.	Reston Publishing, Reston, Virginia, United states	ISBN: 9780879092221
3.	Handbook of Repair and Maintenance of Domestic Electronics Appliances handbook	Shashi Bhushan Sinha	BPB Publications	ISBN: 9788183335027
4.	Modern Computer SMPS Circuits and Fault Finding with D/C PCB layout	ManaharLotia	BPB Publications	---
5.	Practical Electronic Power Supplies	M C Sharma	BPB Publications	---
6.	Practical Electric Motor Handbook	Irving Gottlieb	Elsevier Science & Technology	ISBN: 9780750636384, 9780750636384

(b) List of open source software/learning website :

1. Measuring device: https://www.youtube.com/watch?v=3M4rsWBYaIA
2. Precision measuring device: https://www.youtube.com/watch?v=JX8gHdNpamk
3. Angular measuring device: https://www.youtube.com/watch?v=dgkLbX4cqr4
4. Workshop hand tools: https://www.youtube.com/watch?v=4o0tqF0jDdo
5. Soldering and brazing: https://www.youtube.com/watch?v=BplzRtQAMw0
6. www.electronicshub.org/types-of-inductors-and-applications/
7. www.radio-electronics.com/info/data/semicond/diodes/types-of-diodes.php
8. learn.sparkfun.com/tutorials/transistors

(c) Others:

1. Learning Packages.
2. Lab Manuals.
3. Manufacturers' operating Manual

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications
1.	Hand tools	Insulated Screw drivers ,Pliers , Rawl plug tool and bit Wood chisel, Poker , Splicers , Files , Hack saw, Wood saw, Punch
2.	Tool makers vice	100mm (clamp)
3.	Bench vice	125mm
4.	Allen key set	1-12 mm
5.	Tubular box spanner	6-32 mm
6.	Crimping tool(pliers)	7 in 1
7.	Bearing puller	3 leg 75mm
8.	Analog/Digital Multimeter	AC /DC voltage 0-700V, AC /DC current 0-10A ,Resistance up to 1 M-ohm with diode and capacitor check
9.	Analog Voltmeter	Moving iron and Moving Coil type, 0-250/0-500 V
10.	Analog Ammeter	Moving iron and Moving Coil type, 0-10 /20 A
11.	Milli ammeter DC	0-500 mA
12.	Milli ammeter AC	0-300 mA
13.	Digital Clamp on meter	0-500 V, 0-200 A
14.	Electrical tester	-----
15.	Single phase wattmeter	0-250/300 V, 0-5 /10 Amp
16.	LCR meter	Hand held type Inductance: 0.1 mH to 9999 H, Resolution 0.1 mH Capacitance: 0.1 pF to 9999 mF, Resolution 0.1 pF Resistance: 0.001 Ω to 1 M Ω, Resolution 0.001 W

S. No.	Name of Equipment	Broad Specifications
17.	Hand operated Insulation tester	500V, 100 Mega ohms
18.	Soldering Iron	Soldering iron, Flux for soldering and Solder filler material.
19.	Dual DC regulated power supply	30-0-30V, 2 Amps
20.	Signal Generator with Digital Display for Frequency Amplitude	10 Hz to 100 Khz, 50/600 Ohms (output impedance)
21.	Function generator (DDS Technology (Sine, Square, Triangle, Ramp, Pulse, Serial Data, TTL and Modulation)	1 mHz -10 MHz Function-Pulse – Modulation Generator with Built-in 40MHz Frequency Counter
22.	1-phase Autotransformer	0-270V. 15 Amp
23.	2 channel DSO with channel isolation	70 Mhz
24.	UPS trainer kit	---------
25.	SMPS trainer kit	---------
26.	Water purifier	RO and UV technologies
27.	Washing machine	Auto and semi-automatic
28.	Mixer cum Grinder	---------
29.	Emergency lamp trainer kit	---------
30.	DC Motors	Between 3- 5 HP
31.	Single and three phase AC motors	Between 1-5 HP

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 measuring devices and hand tools effectively	2	2	3	3	1	1	2	1	1	1	3	1
CO-2 Undertake wood working operations economically and safely.	1	2	3	2	1	1	2	2	1	1	1	2
CO-3 Perform various joining operations using welding, brazing and soldering methods	2	2	3	2	1	1	2	2	1	2	3	2
CO-4 Identify electrical and electronics components	2	3	3	2	-	-	1	3	1	2	2	1
CO-5 Use firefighting equipment and other safety related accessories	2	2	2	1	2	2	2	3	2	2	2	1

Legend:1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs& PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)
PO 1,2,3,4,5 6,7,8,9,10 PSO 1,2	CO-1 Identify and test passive and active electronics components	SO-1.1,1.2,1.3,1.4, 1.5	LE1.1,1.2,1.3 1.4.1.5,1.6,1.7
PO 1,2,3,4,5 6,7,8,9,10 PSO 1,2	CO-2Identify various functional blocks/major components in home appliances	SO-2.1,2.2,2.3	LE2.1,2.2,2.3 2.4,2.5
PO 1,2,3,4,5 6,7,8,9,10 PSO 1,2	CO-3 Use reference manuals to troubleshoot faults for a given home appliance	SO-3.1,3.2,3.3	LE3.1,3.2,3.3,3.4
PO 1,2,3,4, 7,8,9,10 PSO 1,2	CO-4 Maintain AC motor starter panels	SO-4.1,4.2,4.3,4.4,	LE4.1,4.2,4.3,4.4,4.5,
PO 1,2,3,4,5 6,7,8,9,10 PSO 1,2	CO-5 Practice dismantling and assembly of a given rotating electrical machine	SO-5.1,5.2,5.3,5.4,5.5	LE5.1,5.2,5.3,5.4.5.5,5.6

Legend: LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies)
SW: Sessional work

Note: The mapping of CO with PO and PSO shown is indicative only. The subject faculty can modify it as per the strengths of the department where the program is conducted

Name of program: Diploma in Engineering **Semester: IV**
Branch : EE/EEE **Code: NIL**
Subject : Indian Constitution **Total Tutorial Periods: NIL**
No. Of Periods : 2 Periods/Week

Course Content-

Unit 1 – The Constitution - Introduction
- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

Unit 2 – Union Government
- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

Unit 3 – State Government
- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

Unit 4 – Local Administration
- District Administration
- Municipal Corporation
- Zila Panchayat

Unit 5 – Election Commission
- Role and Functioning
- Chief Election Commissioner
- State Election Commission

Suggested Learning Resources:

S. No.	Title of Book	Author	Publication
1	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3	Introduction to the Constitution of India	DD Basu	Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/