National Institute of Electronics & Information Technology, Aurangabad

Teaching and Examination Scheme for Diploma in Electronics Production and Maintenance

Program Name: Diploma in Electronics Production and Maintenance

Program Code: DEPM — **With Effect from Academic Year: 2021-2022**

Duration of Program: 6 Semesters — **Duration: 16 Weeks**

Semester: Third

Sr. No	Course Title	Abbreviation	Sub. code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory								Practical				
				L	T	P		Paper Hrs.	ESE		PA		Total			ESE		PA		Total	
									Max	Min	Max	Min	Max	Min		Max	Min	Max	Min	Max	Min	
1	Digital electronics	DET	21D31	4	-	2	6	3	70	28	30	12	100	40		25	10	25	10	50	20	150
2	Analog electronics-II	AE2	21D32	4	-	4	8	3	70	28	30	12	100	40		25	10	25	10	50	20	150
3	Electrical technology-II	ET2	21D33	3	2	2	7	3	70	28	30	12	100	40		25	10	25	10	50	20	150
4	Test and Measurement	TM	21D34	4	-	4	8	3	70	28	30	12	100	40		25	10	25	10	50	20	150
5	Principles of Electronics Communication	PEC	21D35	4	-	2	6	3	70	28	30	12	100	40		25	10	25	10	50	20	150
			Total	**19**	**2**	**14**	**35**	–	–	–	–	–	–	–		–	–	–	–	–	–	**750**

Student Contact Hours Per Week: **35 Hrs.** Medium of Instruction: English

Theory and practical periods of 60 minutes each. Maximum Marks : 750

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

• Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

For the courses having ONLY Practical Examination, the PA has two parts, marks for: (1) Practical Part - 60% of total marks (ii) Micro-Project Part - 40% of total marks.

- **Candidate remaining absent in practical examination will be declare as Absent in Mark List and has to reappear for examination. The marks of the part for which candidate was present will not be processed or carried forward.**

DEAN ACADEMICS
NIELIT, Aurangabad.

Head
Department of Electronics
Dr. Babasaheb Ambedkar Marathwada University
Aurangabad-431004

Associate Professor
Dept. of Electronics & Tele. Engg.,
Govt. College of Engineering

कार्यकारी निदेशक
Executive Director
रा.इ.सू.प्रौ.सं., औरंगाबाद
NIELIT, Aurangabad

National Institute of Electronics & Information Technology ★ NIELIT Aurangabad (MS)

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Third
Course Title : Digital electronics
Course Code : 21D31

1. RATIONALE

Digital electronics is a foundation Course for electronics student. Its purpose is to develop proper understanding of basic logic gates, combinational and sequential logic circuits using discrete gates as well as digital ICs. While teaching the subject, teachers should make maximum use of demonstrations to make the subject interesting to the students.

2. COMPETENCY

The intention of this route is to help the student to achieve the following enterprise recognized competency thru various coaching mastering stories

- Construct/ take a look at digital circuits consist of digital ics.

3. COURSE OUTCOMES (COs)

The concept, sensible experiences and relevant tender skills associated with this path are to be taught and implemented, in order that the student demonstrates the following industry-orientated COs related to the above-cited competency:

a. Use Boolean expressions to realize logic circuits.
b. Build simple sequential circuits.
c. Use number system and codes for deciphering working of digital system
d. Build simple combinational circuits
e. Test data converters and PLDs in digital electronics systems

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper His.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	6	3	70	28	30	12	100	40	25	10	25	10	50	20	

(*): Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; **T -** Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C -** Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Test the functionality of specified logic gates using breadboard. {IC 7404, 7408.7432-7486)	II	02*
2	Test the functionality of NAND and NOR gate of using breadboard (IC 7400 and 7402)	II	02

3	Construct AND, OR, NOT yates using universal gates.	II	02
4	Build the logic circuit on breadboard to check the De Morgan's theorems.	II	02
5	Design Half adder and Half subtracter using Boolean expressions.	III	02*
6	Design Full adder and full subtracter	III	02
7	Construct and test BCD to 7 segment decoder using IC 7447/ 7448.	III	02
8	Build / test function of MUX 74151/74150/any other equivalent	III	02
9	Build / test function of DEMUX 74155/74154/any other equivalent.	Ill	02
10	Build / test function of RS flip flop using NAND Gate.	IV	02*
11	Build / test function of MS JK flip flop using 7476.	IV	02
12	Use IC 7476 to construct and test the functionality of D and T flip flop.	IV	02
13	Implement 4-bit ripple counter using 7476.	IV	02
14	Use IC 7490 to construct decade counter (MOD-10).	IV	02
15	Implement 4-bit universal shift register.	IV	02
16	Build R-2R resistive network on breadboard to convert given digital data into analog.	V	02*
		Total	**32**

Note:

i. *A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below;*

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and conclusion	20
f.	Answer to sample questions	10
g.	Submission of report m time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- • 'Valuing Level' in 1M year
- 'Organizing Level" in 2nt year
- 'Characterizing Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Digital Multimeter: 3 and 14 digits with R, V, I measurements, diode and BJT testing.	All
2	CRO : Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 MHz XIO magnification 20 ns max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out.	16
3	Pulse generator TTL pulse generator	10-15
4	DIGITAL IC tester: Tests a wide range of Analog and Digital ICs such as 74 Series. 40/45 Series of CMOS ICs.	1-15
5	Bread Board Development System: Bread Board system with DC power output 5V, +/-12V and 0-5V variable, digital voltmeter, ammeter. LED indicators 8 no, logic input switches 8 no, 7segment display 2 no, clock generator, Manual pulser, Breadboard with about 1,600 points. Potentiometer, relay etc.	1-15
6	Trainer kits for digital ICs: Trainer kit shall consist of digital ICs for logic gates, flop-Hop, shift registers, counter along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	1-15
7	Regulated power supply: Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation	1-16
8	Trainer kit for 4-bit Counter using Flip Flops: 4-bit ripple counter. Synchronous Counter. IC 7476 based circuit. Input given by switches and output indicated on LED. Facility to select MOD 8 or MOD 16 mode. Built in DC power supply and manual pulser with indicator.	13

7. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit -1 Number System and Codes	1a. Convert the given number into the specified number system. 1b. Perform the binary arithmetic operation on the given binary numbers. 1c. Convert the given coded number into the other specified code 1d. Add the given two decimal numbers using BCD code.	1.1 Number System: base or radix of number system, binary, octal, decimal and hexadecimal number system. 1.2 Binary Arithmetic: Addition, subtraction, multiplication, division. 2 1.3 Subtraction using 1's complement and 2's complement. 1.4 BCD, Gray Code, Excess-3, and rode. 1.5 BCD Arithmetic: BCD Addition
Unit - II Logic gates and logic families	2a. Develop the basic gates using the given NAND/NOR gate as universal gate.	2.1 Logic gates: Symbol, diode/ transistor switch circuit and logical expression, truth table of basic logic gates (AND, OR, NOT), Universal

	2b. Simplify the given expression using Boolean laws. 2c. Develop logic circuits using the given Boolean expressions. 2d. Compare the salient characteristics of the given digital logic families	gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR), Tristate logic 2.2 Boolean algebra: Laws of Boolean algebra, Duality Theorem, De-Morgan's theorems 2.3 Logic Families: Characteristics of logic families: Noise margin, Power dissipation, Figure of merit, Fan-in and fan-out, Speed of operation, Comparison of TTL, CMOS, types of TTL NAND gate
Unit- III Combinational Logic Circuits	3a. Develop logic circuits in standard SOP/ POS form for the given logical expression. 3b. Minimize the given logic expression using K-map. 3c. Use IC 7483 to design the given adder/ subtractor. 3d. Draw MUX/DEMUX tree for the given number of input and output lines. 3e. Write the specifications of (be component for the given application. 3f. Develop the specified type of code	3.1 Standard Boolean representation: Sum of Product (SOP) and Product of Sum(POS), Min-term and Max-term, conversion between SOP and POS forms, realization using NAND /NOR gates 3.2 K-map reduction technique for the Boolean expression: Minimization of Boolean functions up to 4 variables (SOP and POS form) 3.3 Design of arithmetic circuits and code converter using K-map: Half and full Adder, half and full Subtractor, gray to binary and binary to gray (up to 4 bits) 3.4 Arithmetic circuits: (IC 7483) Adder and Subtractor, BCD adder 3.5 Encoder/Decoder: Basics of encoder, decoder, comparison, (IC 7447) BCD to 7 segment decoder/driver 3.6 Multiplexer and Demultiplexer: working , truth table and applications of Multiplexers and De-multiplexers. MUX tree, IC 74151asMUX: DEMUX tree. DEMUX as decoder, IC 74155 as DEMUX 3.7 Buffer: Tristate logic, unidirectional and bidirectional buffer(IC 74ls244,74LS245)
Unit- IV Sequential Logic Circuit	4a. Use relevant triggering technique for the given digital circuit. 4b. Use the given flip-flop to construct the specific type of counter. 4c. Use excitation table of the given flip-flop to design synchronous counter 4d. Design the specified modulo-N counter using IC7490. 4e. Construct ring/ twisted ring counter using the given flip-flop.	4.1 Basic memory cell: RS-latch using NAND and NOR 4.2 Triggering Methods: Edge trigger and level trigger 4.3 SR Flip Flops: SR-flip flop, clocked SR flip flop with preset and clear, drawbacks SR flip Hop 4.4 JK Flip Flops: Clocked JK Flip flop with preset and clear, race around condition in JK flip flop, Master slave JK flip flop, D and T type flip flop Excitation

		table of flip flops. Block schematic and function table oflC-7474.7475 4.5 Shift Register: Logic diagram of 4-bit Shift registers - Serial Input Serial Output, Serial Input Parallel Output. Parallel Input Serial Output, Parallel Input Parallel Output, 4 Bit Universal Shift register 4.6 Counters: Asynchronous counter: 4-bit Ripple counter, 4 bit up/down Counter, modulus of counter Synchronous counter: Design of 4 bit synchronous up/down counter Decade counter: Block schematic of IC 7490 Decade counter, IC 7490 as MOD-N Counter, Ring counter, Twisted ring counter
Unit- V Data Converters and PLDs	5a. Calculate the output voltage of the R-2R ladder for the given specified digital input. 5b. Calculate the output voltage of the weighted resistor DAC for the given specified digital input. 5c. Explain with sketches the working principle of the M1 given type of ADC. 5e. Explain with sketches the working principle of the given types of memories. 5d. Explain with basic block diagram the working principle of the given type of programmable	5.1 Data Converter: DAC: Types, weighted resistor circuit and R-2R ladder circuit, DAC IC 0808 specifications ADC: Block Diagram, types, and working of Dual slope ADC, SAR ADC, ADC IC 0808/0809. Specification 5.2 Memory: RAM and ROM basic building blocks, read and write operation, types of semiconductor memories 5.3 PLD: Basic building blocks and types of PLDs. PLA. PAL. GAL 5.4 CPLD: Basic Building blocks,

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Number System	06	2	2	4	08
II	Logic gates and logic families	10	4	4	4	12
III	Combinational Logic Circuits	16	4	6	8	18
IV	Sequential Logic Circuit	16	4	6	8	18
V	Data Converters and PLDs	16	4	4	6	14
Total		**64**	**18**	**22**	**30**	**70**

Legends: *R=Remember, U'-Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: This *specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table*

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of (he various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare the survey report on the applications of different types of number system and code converters used in the design of digital system.
b. Compare technical specifications and applications of various types of memory, PLDs, CPLDs and Prepare report.
c. Test digital ICs using various testing equipment like digital IC tester. Digital multimeter etc.
d. Give seminar on any course relevant topic.
e. Conduct library / internet survey regarding different data sheet and manuals.
f. Prepare power point presentation on digital circuits and their applications.
g. Undertake a market survey of different digital ICs required for different applications.
h. Search for video / animations / power point presentation on internet for complex topic related to the course and make a presentation.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses *(MOOCs)* may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations.
d. With respect to item No. 9, teacher need to ensure create opportunities and provisions for *co-curricular activities.*
e. Guide student(s) in undertaking micro-projects.
f. PPTs/Animations may be used to explain the construction and working of electronic circuits.
g. Guide students for using data sheets / manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16*** (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Build a Digital IC tester circuit.

b. Build a 4bit parity generator and parity checker circuit.
c. Build a circuit to implement 4-bit adder.
d. Build a circuit to test 7 segment display.
e. Build a circuit to implement debounce switch.
f. Build a circuit for LED flasher.
g. Build a circuit for LED BAR display
h. Design and analyze digital arithmetic circuit

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Digital Electronics, Principles and Integrated Circuits	Maini. Anil K.	Wiley India, Delhi, -ISBN: 9780470032145
2	Digital Electronics	Puri. V.K.	McGraw Hill. New Delhi, 2016, ISBN: 97800746331751
3	Digital Circuits and Design	Salivahanan S.: Arivazhagan S.	Vikas Publishing House, New Delhi, 2013. ISBN: 9789325960411
4	Digital Principles	Malvino. A.P.: Leach. D.P.; Saha G,	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405
5	Digital Design	Mano, Morris; Ciletti. Michael D.	Pearson Education India, Delhi. ISBN: 9780131989245
6	Modern Digital Electronics	Jain. R.P.	McGraw-Hill Publishing, New Delhi ISBN: 9780070669116

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.scs.ryerson.ca/~aabhari/cps213Chapter5.ppt
b. www.eng.wayne.edu/~singhweb/seql.ppt
c. www.aIlaboutcircuits.com/vol_4/chptl3/3.html
d. www.youtube.com/watch?v=5Wz5f3n5sjs
e. www.eee.metu.edu.tr/~cb/e447/Chapter%209%20-%20v2.0.pdf
f. www.cosc.brocku.ca/Offerings/3P92/seminars/Flash.ppt
g. www.webopedia.com/TERM/RyRAM.html
h. www.cs.sjsu.edu/~lee/csl47/Rahman.ppt

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Third
Course Title : Analog electronics-II
Course Code : 21D32

1. RATIONALE

More suitable use of electronic devices has made electronics engineers to deal with the various styles of digital circuits which generate the desired analog/digital output. Transistor has remarkably increased the application of digital system. Discrete components are extensively utilized in amplifiers and different electronic systems which the diploma holders (also referred to as as technologist) should use or preserve. Getting to know of basic operating principles of digital circuits will help the students to apply the basic digital equipment. This route is advanced in this kind of manner that, college students could be capable of follow the information of simple digital circuit operating to resolve large based totally digital engineering utility issues.

2. COMPETENCY

The goal of this subject is to assist the student to attain the following enterprise recognized competency via diverse teaching learning studies:

- **Use Analog devices and power amplifier.**

3. COURSE OUTCOMES (COs)

The concept, practical studies and relevant soft skills associated with this route are to be taught and carried out, so that the pupil demonstrates the following enterprise-orientated COs associated with the above-cited competency:

a. Use transistor as low Power amplifier**.**
b. Use BJT as high-Power amplifier.
c. Use BJT as feedback amplifier.
d. Use BJT as waveform generator.
e. Maintain IC voltage regulator and SMPS.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper His.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	4	8	3	70	28	30	12	100	40	25	10	25	10	50	20	

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.
Legends: L-Lecture; **T -** Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C -** Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5. SUGGESTED PRACTICAL/ EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.
*** Use bread board for the following Practical (wherever applicable).**

DEPM **Semester III**

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Build/test the performance of single stage Low Power common emitter amplifier.	I	**2***
2	Simulate / test output Wave form of single stage common emitter (CE) amplifier using simulation software(like spice, multisim).	I	2
3	Simulate/test the output Wave form of single Stage common source FET amplifier using simulation software	I	2
4	Build/test the performance of single stage Common source FET amplifier.	I	2
5	Build/test the performance of two stage RC Coupled common emitter amplifier using transistor.	I	2*
6	Build/test the performance of two stage direct Coupled amplifier using transistor.	I	2
7	Build/Test the performance of transformer Coupled amplifier, (Part-I)	I	2s
8	Build/Test the performance of transformer Coupled amplifier.(Part-II)	I	2*
9	Build/test the performance of single tuned amplifier using transistor.	I	2
10	Build/test performance of double tuned common Emitter amplifier. (Part-I)	I	2
11	Build/test performance of double tuned common Emitter amplifier. (Part-II)	I	2
12	Build/test performance parameters of single stage class A power amplifier.	II	2
13	Build/test performance parameters of class B Push pull amplifier using transistor.	II	2
14	Build/test the performance of Audio power amplifier.	II	2*
15	Use transistor to build/ test voltage series Feedback amplifier parameters with and without feedback.	III	2
16	**Use** transistor to built/ test voltage shunt Feedback amplifier parameters with and without feedback.	III	2
17	Test the effect of positive and negative feedback on the given amplifier.(Part-I)	III	2*
18	Test the effect of positive and negative feedback on the given amplifier.(Part-Il)	III	2*
19	Build RC phase shift oscillator and measure the generated frequency using CRO.	IV	2
20	Build Crystal oscillator and measure the generated frequency using CRO.	IV	2
21	Simulate Hartley oscillator using any relevant simulation software. (Like spice, multisim. Lab view, LTspice, Octeva).	IV	2*
22	Generate a waveform using Miller's sweep generator and measure sweep time and retrace time.	IV	2
23	Simulate dual voltage regulator using JC78XX and 79XX for **the** specified regulated output voltage	V	2*
24	Build dual voltage regulator for the specified Regulated output voltage.	V	2
25	Build low voltage regulator using IC723 for the given regulated output voltage. (2V to7V)	V	2 *
26	Build high voltage regulator using IC723for the given regulated output voltage.(7V to37V).	V	2
27	Test the performance parameters of voltage regulator using IC LM317	V	2*
Total			**54**

Note:

i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practiced need to be performed, out of which, the practical marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below;

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in I^{s1} year
- 'Organizing Level ' in 2nd year
- 'Characterizing Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO.S. No.
1	Variable DC power supply 0- 30V, 2A, SC protection	All
2	Dual Power supply 0- 30V, 2A	All
3	Cathode Ray Oscilloscope, Dual Trace 30Mhz and above, l MegaΩ Input Impedance	1-16
4	Digital storage Oscilloscope, Dual Trace 20Mhz and above, lMegafi Input Impedance	1-16
5	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude	1-12
6	Digital Multimeter: 3and l/2 digit display, 9999 counts digital multimeter measures: V_{ac}, $V_{t\|C}$ (1000V max), A ($j_{C;}$ A_{ac} (10 amp max), Resistance (0 -100 Mfi), Capacitance and diode ,transistor tester	All

7	Electronic Work Bench : Bread Board 840 -1000 contact points, Positive and Negative power rails on opposite side of the board , 0-30 V , 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO 0-30MHz , Digital multimeter	All
8	LCR-Q meter, Test frequency standard 100 Hz / 1 kHz; Parameter L-Q, CD, R-Q and Z-Parameters L 100 Hz, 120 Hz 1 mH - 9999 H 1 KHz 0.1 mH - 999.9 Ht, C 100 Hz, 120Hz 1 pF - 9999 mF Range 1 KHz 0.1 pF - 999.9 mF, Terminals 4 terminals.	All

7. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit -1 Low Power Amplifiers	la. Explain with sketches the working principle of the given type of amplifier, lb. Calculate gain and bandwidth of the given low power amplifier, lc. Compare performance parameters of the given types of amplifier coupling. Id. Select relevant tuned amplifier for the given frequency band with justification, le. Describe the environment employed for the given simulation work with justification.	1.1 Classification of Amplifiers, BJT as an amplifier. 1.2 Single stage CE amplifier, frequency response, gain, bandwidth 1.3 Multistage amplifier: General Multistage amplifier BJT based. 1.4 Type of BJT amplifier coupling: Circuit diagram, operation, frequency response and applications of RC transformer and direct coupling 1.5 FET Amplifier: Common Source amplifier, working principle and applications 1.6 Tuned Amplifier: Need of tuned amplifier, basic tuned circuit, circuit diagram, operating principle and frequency response of Single tuned. Double tuned and stagger tuned amplifiers
Unit-II High Power Amplifiers	2a. Explain with sketches the working of the given type of power amplifier. 2b. Select the relevant power amplifier for the given application with justification, 2c. Calculate efficiency of the given power amplifier. 2d. Compare the performance parameters of the given types of power amplifiers. 2e. Prepare the specifications of the given type of amplifier.	2.1 Power Amplifier: Comparison between small signal amplifier and power amplifier, performance parameter of power amplifier like: bandwidth, gain, frequency band, efficiency *2.2* Classification: Class A, Class B, Class AB and Class C 2.3 Circuit, operation, input /output waveforms, efficiency and power equations of Single Stage Class A, Class B, Class AB and Class C Power amplifier.
Unit III Feedback Amplifiers	3a. Calculate the gain of the amplifier for the given type of feedback amplifier. 3b. Explain effect of negative feedback on the given type of amplifier performance.	3.1 Principle of feedback Amplifier 3.2 Types of feedback: negative and positive feedback, advantages and disadvantages of negative feedback

	3c. Calculate Gain, Bandwidth, Input and Output resistance of the given feedback amplifier. 3d. Compare the performance of given types of negative feedback amplifiers.	3.3 Types of feedback connections, voltage shunt, voltage series, current series and current shunt: block diagram, circuit diagram, and operation
Unit IV Wave form Generators	4a. Calculate frequency of oscillation for the given type of oscillator circuit. 4b. Select the relevant oscillator to obtain the given range of frequency with justification. 4c. Choose the relevant sweep generator to obtain the specified saw tooth waveform with justification. 4d. Prepare the specifications of the given oscillator.	4.1 Oscillators: Need, oscillator and amplifier 4.2 Condition for oscillation (Barkhausen's criteria), classification of oscillators 4.3 Sine wave Oscillator: RC Phase shift oscillator and crystal oscillator, concept. working and applications 4.4 Sweep generator: Miller sweep, Bootstrap circuit, current time base generator
Unit- V IC Voltage Regulators and SMPS	5a. Explain with sketches the working principle of given type of voltage regulator IC. 5b. Compare the working of the given types of regulators. 5c. Design voltage regulator for the specified output voltage. 5d. Interpret the working of given block of the SMPS.	5.1 Types of IC Voltage Regulator: Fixed and variable: 78XX, 79XX, specification, series and LM723, LM317, line and load regulation. 5.2 SMPS: Block diagram, working principle, specifications, special features, advantages, disadvantages and applications. 5.3 Use of heat sink for regulated power supply

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's Cognitive Domain Taxonomy'.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Low Power Amplifiers	14	4	6	6	16
II	High Power Amplifiers	18	4	6	8	18
III	Feedback Amplifiers	12	4	4	4	12
IV	Waveform Generators	12	4	4	6	14
V	IC voltage Regulators and SMPS	08	2	4	4	10
Total		**64**	**18**	**24**	**28**	**70**

Legends: R=Remember, U=Understand, A= Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Undertake micro-projects.
b. Give seminar on any relevant topic.
c. Library survey regarding different electronics circuits and voltage regulators.
d. Prepare power point presentation for electronic circuits.
e. Undertake a market survey of different electronics circuits and voltage regulators.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b. 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations.
d. With respect to item No. 9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
e. Guide student(s) in undertaking micro-projects.
f. Guide students for using data manuals.
g. Use PPTs to explain the construction and working of rectifier.
h. Use PPTs to explain the construction and working of wave shaping circuits

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Construct a doorbell using transistor.
b. Using transistor construct a clap switch.
c. Construct audio amplifier using (IC810 or equivalent IC).
d. Construct power amplifier for FM receiver output.
e. Drive a speaker using class A amplifier which is directly coupled and test its performance parameters.
f. Using Class AB push pull amplifier drive speaker, test its performance parameters.
g. IC regulators: Build a circuit of Dual regulated power supply on general purpose PCB to obtain +/- 15 V, 500mA using IC 78XX & 79XX series.
h. IC regulators: Build a regulated power supply on general purpose PCB to obtain + 5V, 500mA using IC 78XX series. Drive suitable load with regulated output.

i. IC regulators: Build a regulated power supply on general purpose PCB to obtain-20V, 500mA using IC 79XX series. Use suitable heat sink. Drive suitable load with regulated output.

j. IC Regulators: Build a constant current regulator on general purpose PCB for output current of 125mA using IC 317.

k. IC Regulators: Construct low voltage regulator on general purpose PCB for output

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Devices and Circuit Theory	Boylestead. Robert. Neshelsky, Louis	Pearson Education, New Delhi, 2014. ISBN: 9780132622264
2	Modem Power Electronics	Sen, P.C.	S.Chand, New Delhi, 2015 ISBN:9788121924252
3	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S.Chand, New Delhi, 2014 ISBN:8121924502
4	Fundamental of Electronic Devices and Circuits	Bell,	Oxford University Press, New Delhi. 2015, ISBN:9780195425239
5	Electronic Devices and Circuits	Millman, Jacob Halkias, C. Christos Jit, Satyabrata	Mc Graw Hill Education, New Delhi 2015, ISBN:9789339219550
6	Applied Electronics	Sedha, R.S.	S.Chand. New Delhi, 2015 ISBN:9788121927833

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.colorado.edu/physics/phys3330/PDF/Experiment7.pdf
b. www.alldatasheet.com/view.jsp?Searchword=Bcl47
c. www.williamson-labs.com
d. www.futurlec.com
e. www.radio-electronics.com/info/power-management/switching-mode-power-supply/basics-tutori al .php
f. www.circuitstoday.com/ic-723-voltage-regulators

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Third
Course Title : Electrical Technology-II
Course Code : 21D33

1. RATIONALE

In industry, to build and take a look at electronic/electrical circuits in extraordinary conditions know-how of electrical circuits and networks could be very vital. This subject is meant to expand the abilities to diagnose and rectify the electric networks and circuit associated problems inside the industry. The idea and standards of circuit evaluation lays the foundation to recognize courses of advance technologies.

2. COMPETENCY

The goal of this subject is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Diagnose the electrical and electronic circuits problems.

3. COURSE OUTCOMES (COs)

The curriculum associated with this subject are to be trained and applied, in order that the student demonstrates the subsequent industry-oriented COs related to the above-stated competency:

a. Use the working of single phase a.c. circuits.
b. Check the resonance condition of electric/electronic circuits.
c. Check the functionality using the principles of circuit analysis.
d. Use network theorems to determine the various parameters in circuits.
e. Use two port networks to determine the circuit parameters.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Examination Scheme													
				Theory							Practical						
L	T	P	Credit (L+T+P)	Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Mas	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	2	2	7	3	70	28	30	12	100	40	25	10	25	10	50	20	

(*): Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; **T -** Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C -** Credit. **ESE** - End Semester Examination; **PA -** Progressive Assessment.

5. SUGGESTED PRACTICAL/ EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Determine active, reactive and apparent power consumed in given R-L series circuit and draw phasor diagram.	I	02

2	Determine active, reactive and apparent power consumed in given R-C series circuit and draw phasor diagram.	I	02
3	Determine active, reactive and apparent power consumed in given R-L-C series circuit and draw phasor diagram.	I	02*
4	a. Measure currents in R-C parallel A. C. circuit. b. Determine p.f. active, reactive and apparent power in R-C parallel A.C. circuit	I	02
5	a. Measure currents in each branch of given R-L-C parallel a. c. circuit. b. Determine p.f. active, reactive and apparent power for given R-L-C Parallel circuit with series connection of resistor and inductor in parallel with capacitor.	I	02
6	Determine initial and final voltage across the capacitor at $t=0^-$ and $t=0^+$.	I	02
7	Determine initial and final current through the inductive coil at t=0" and $t=0^+$	I	02
8	Create resonance in given R-L-C circuit by varying L and C or by using variable frequency supply.	II	02*
9	Determine current, through the given branch of an electric network by applying mesh analysis.	III	02
10	Determine voltage at the particular node and current through any given branch of the network by applying nodal analysis.	III	02*
11	Determine current through the given branch and voltage across the given element of circuit by applying superposition theorem .	IV	02*
12	Determine equivalent circuit parameter in a given circuit by applying Thevenin's and Norton's theorem .	IV	02
13	Determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem .	IV	02
14	Test the response of the given circuit by applying reciprocity theorem.	IV	02
15	Determine open circuit (Z) parameters for the given network.	V	02*
16	Determine short circuit (Y) parameters for the given network.	V	02
17	Determine transmission (ABCD) parameters for the given network.	V	02
	Total		**34**

Note

i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs anil competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry,

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed, according to a suggested sample given below:

S. **No.**	**Performance Indicators**	**Weightage in %**
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

a. Follow safe practices

b. Practice good housekeeping
c. Practice energy conservation
d. Demonstrate working as a leader/a team member
e. Maintain tools and equipment
f. Follow ethical practices.

The ADOs are not specific to any one PrO. but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to KrathwohPs 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in I^{s}' year
- 'Organizing Level' in 2"^{d} year
- 'Characterizing Level' in 3rd year.

6. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

s. **No.**	Equipment Name with Broad Specifications	**PrO. No.**
1	Ammeters MI Type: AC/DC, 0-lAmp,0-1.5 Amp.O-2.5Amp,0-5Amp.	1 to 17
2	Voltmeter MI Type: AC/DC, 0-150/300V, 0-250/500V,0-75/150V.	1 to 17
3	Ammeters PMMC Type: DC, 0-1.5/3Amp, 0-2.5/5 Amp, 0-5/10 Amp.	1 **to** 17
4	Voltmeter PMMC Type**:** DC**,** 0-150/300V, 0-250/500V.O-75/150V.	1 **to** 17
5	Wattmeter: Single phase 2.5/5Amp, 200/400V. Single phase 5/10Amp, 250/500V	1 to 17
6	Low power factor wattmeter: Single phase. 5/10 Amp, 250/500V.	1 to 5
7	Wattmeter: Dynamometer type, single phase. 5Amp, 250V.	1 to 5
8	Power factor meters: AC, 230V,45-50-55 Hz , single phase, 5-10 Amp, 250 V.	1 to 5
9	Digital storage oscilloscope 50MHz.	6,7
10	Trainer kit for all theorems	9 **to** 17

7. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	**Unit Outcomes (UOs)** (in **cognitive domain)**	**Topics and Sub-topics**
Unit -I **Single Phase A.C. Circuits**	1a. Compare the A.C. responses in the given type of series and parallel circuits. 1b. Explain with sketches the phasor diagram of the given AC circuit 1c. Calculate active, reactive, apparent power and power factor for the specified circuit. 1d. Suggest the power factor improve technique for the given situation with justification, le. Calculate admittance, conductance and susceptance for the given circuit. 1f. Determine the equivalent impedance and admittance for the	1.1 Series A.C. circuits: R-L, R-C and R-L-C circuits, impedance, reactance, phasor diagram, impedance triangle, power factor, active(real) power, apparent power, power triangle. 1.2 AC Series circuit by using complex algebra Parallel 1.3AC circuits: Resistance in parallel with pure inductance and capacitance, series combination of resistance and inductance in parallel with capacitance 1.4 Concept of admittance, conductance and susceptance 1.5 Concept of initial and final conditions in switching circuits, Meaning of t = 0 t = 0+

	given circuit. 1g. Interpret the working of the given R,L, and C component using initial and final condition.	and t =∞ R, L and C at initial and final conditions
Unit-II Resonance in Series and Parallel Circuits	2a. Find the resonance condition for the specified series and parallel circuits. 2b. Calculate current, voltage and frequency for the given resonant circuit. 2c. Determine bandwidth and quality factor(Q) for the given series and parallel resonant circuit. 2d. Describe the procedure to tune the given electrical circuit using the principles of resonance.	2.1 Series and parallel resonance 2.2 Impedance and phase angle of a Series and parallel resonant circuits 2.3 Voltage and current in a series and parallel resonant circuit 2.4 Bandwidth of a RLC circuit (series and parallel resonance) 2.5 Quality factor (Q) and its effect on bandwidth (series and parallel resonance) 2.6 Magnification in series and parallel resonance circuits
Unit-III Principles of Circuit Analysis	3a. Use source transformation techniques for the given circuit. 3b. Convert the given star connection to delta connection and vice versa, 3c. Use mesh analysis to solve the given network. 3d. Solve the given network using nodal analysis. 3e. Diagnose the fault in the given circuit using the relevant technique(s).	3.1 Source transformation 3.2 Star/delta and delta/star transformations 3.3 Mesh analysis 3.4 Node analysis
Unit-IV Network Theorems	4a. Use superposition theorem to calculate the given parameters in the given circuit. 4b**.** Apply Thevenin's theorem to calculate the given parameters in the given circuit. 4c. Use Norton's theorem to calculate the given parameters in the circuit. 4d. Calculate load impedance using maximum power transfer theorem for the given circuit, 4e. Use reciprocity theorem to analyze the given circuit.	4.1 Superposition theorem for both AC voltage and DC source 4.2 Thevenin's theorem 4.3 Norton's theorem 4.4 Maximum power transfer theorem 4.5 Reciprocity theorem 4.6 Superposition theorem
Unit-V Two Port Networks	5a. Calculate Z, Y, parameters for the given circuit. 5b. Find the ABCD parameters for the given circuit. 5c. Sketch the phasor diagram for the given T and *n* circuit with justification. 5d. Calculate Z and Y parameters to test whether the given circuit is reciprocal or symmetrical two port network.	5.1 Significance of two port network 5.2 Open circuit(Z) and short circuit(Y), Parameters 5.3 Transmission (ABCD) parameter 5.4 T and *n* representation of circuits 5.5 Reciprocal and symmetrical two port network(no derivation) 5.6 AC motors: Principle of single-phase induction motor, speed -torque characteristics, and applications.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Single Phase A.C. Circuits	10	04	04	06	14
II	Resonance in Series and Parallel Circuits	10	02	06	06	14
III	Principles of Circuit Analysis	10	04	04	06	14
IV	Network Theorems	12	04	06	08	18
V	Two port networks	06	02	04	04	10
	Total	**48**	**16**	**24**	**30**	**70**

Legends: R=Remember, U=Understand. A =Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Follow the safety precautions.
c. Use various meters to test electric/Electronic equipment and component.
d. Library/Internet survey of electrical circuits and network.
e. Prepare power point presentation or animation tor understanding different circuits behavior.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

h. Massive open online courses *(MOOCs)* may be used to teach various topics/sub topics.
i. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
j. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations.
k. With respect to item No. 9, teacher need to ensure create opportunities and provisions for *co-curricular activities.*
l. Guide student(s) in undertaking micro-projects.
m. PPTs/Animations may be used to explain the construction and working of electronic circuits.
n. Guide students for using data sheets / manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students

in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Single **Phase A.C. series and parallel Circuits:** Prepare series and parallel circuit using variable R, L and C combination on the bread board. Measure the response and draw vector diagram. Also calculate power factor for the circuit. Write report on the same.
b. **Resonance in series and Parallel Circuits:** Prepare series RLC circuit using variable R, L and C combination on the bread board. Tune the circuit for resonance condition. Measure the responses and calculate band width and Q-factor for the circuit, Write report on the same.
c. **Resonance in Series and parallel Circuits:** Prepare parallel RLC circuit using variable R, L and C combination on the bread board. Tune the circuit for resonance condition. Measure the response and calculate band width and Q-factor for the circuit. Write report on the same.
d. **Principles of circuit analysis:** Prepare power point presentation on source transformation, star delta transformation, mesh and nodal analysis and give presentation in the class room.
e. **Network Theorems:** Select suitable components for the given circuit and prepare **the** same on the bread board. Verify the following network theorem theoretically and practically.
    i. Superposition Theorem
    ii. Maximum power transfer theorem
    iii. Thevenin's theorem
    iv. Norton'**s** theorem,
f. **Two Port Networks:** Design and prepare two port networks on bread board for given values of open circuit Z parameter.
g. **Two Port Networks:** Design and prepare two port networks on bread board for given values of short circuit Y parameter.

12. SUGGESTED LEARNING RESOURCES

s. No.	**Title of Book**	**Author**	**Publication**
1	Basic Electrical Engineering	Mittle, V.N.; Mittle, Arvind	McGraw Hill Education, Noida, 2005, ISBN: 9780070593572
2	A Text Book of Electrical Technology Vol-I	Theraja, B. L, **:** Theraja, A. K.	S. Chand and Co., New Delhi, 2006 ISBN: 978-81-219-2440-5
3	Fundamentals of Electrical Engineering	Saxena, S.B.; Dasgupta, K.	Cambridge university press pvt. Ltd., New Delhi, 2016, ISBN : 9781107464353
4	Circuit and network	Sudhakar, A.; Palli Shyammohan, S.	McGraw Hill, New Delhi, 2006 ISBN : 978-0-07-340458-5
5	Electric Circuits	Bell, David A.	Oxford University Press New Delhi, 2009 ISBN: 9780195425246
6	Electric Circuit Analysis	Paranjothi, S.R.	New Age Publisher, New Delhi, 2011. ISBN: 978-81-224-3154-4
7	Fundamentals of Electrical Networks	Gupta, B.R; Singhal, Vandana	S.Chand and Co., New Delhi, 2005 ISBN: 978-81-219-2318-7

8	Schaum's Outline of Electric Circuits	Edminister, Joseph A. Nahvi,Mahmood	McGraw Hill, New Delhi, 2013 ISBN: 9780070189997
9	Introductory circuit Analysis.	Boylested, R**.L.**	Wheeler, New Delhi ,2013 ISBN: 978-0023131615

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.ni.com/multisim
b. www.dreamtechpress.com /ebooks
c. www.nptelvideos.in/electrical engineering/ circuit theory
d. www.leamerstv.com/free-engineeritiL;
e. electronicsforu.com/category/electronics-projects

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Third
Course Title : Test and Measurement
Course Code : 21D34

1. RATIONALE

Test and Measurement is a rising subject, used for statistics sensing, acquisition, transmission, evaluation and control in diverse sensible packages. Analog and Digital instruments are particularly used to degree distinctive process manipulate parameters. The physical portions/parameters are be convened into electrical signal with the help of numerous forms of sensors and transducers and extensively utilized to hold electronic manage and automation gadget. Managing take a look at and measuring tool is the crucial pastime of the degree engineering bypass outs (additionally known as technologists) after they paintings in any digital automation industry.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Test and Measurement of electronic system in process and manufacturing industries.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a. Use various types of transducers and sensors to measure quantities.
b. Maintain signal conditioning and data acquisition system.
c. Calibrate different electronic instrument,
d. Use the relevant instrument to measure specified parameters.
e. Interpret working of various types of sensors and transducers.
f. Interpret the characteristics of measuring instrument.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit	Examination Scheme													
				Theory							Practical						
L	T	P	(L+T+P)	Paper His.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	4	8	3	70	28	30	12	100	40	*25*	10	25	10	100	40	

(*): Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; **T -** Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C -** Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. SUGGESTED PRACTICALS/EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

s. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required

1	Use analog multimeter to determine accuracy, resolution and hysteresis for specified measured quantity	I	02*
2	Use analog meters to measure voltage, current and resistance	I	02*
3	Use digital meters to measure voltage, current and resistance.	III	02*
4	Calibrate the given analog voltmeter.	II	02*
5	Calibrate the given analog ammeter.	II	02
6	Select the relevant range of CRO for various measurement by varying positions of front panel knobs.	III	02
7	Use CRO to measure amplitude and frequency of the given input signal.	III	02
8	Generate Lissajous pattern on CRO to measure frequency of the given input signal.	III	02*
9	Generate Lissajous pattern on CRO to measure phase of the given input signal	III	02
10	Use function generator to generate different types of waveforms and observe them on DSO.	III	02
11	Use DSO to measure amplitude and frequency of the given input signal.	III	02
12	Use spectrum analyzer to measure frequency band of the given input signal.	III	02
13	Test the characteristics of the potentiometer.	IV	02*
14	Test relation between Linear displacement and output voltage using LVDT.	IV	02
15	Use strain gauge to measure applied pressure.	V	02*
16	Use RTD (Pt-100) to measure temperature of the given liquid.	V	02*
17	Use thermocouple to measure temperature of liquid.	V	02
18	Use bourdon tube and LVDT to measure applied pressure.	V	02*
19	Use venturi tube to measure flow of fluid.	V	02
20	Use orifice plate to measure flow of fluid.	V	02
21	Use rotameter to measure flow of liquid.	V	02*
22	Use pH meter to measure pH value of given solution.	V	02*
23	Use multimeter/CRO to measure voltage at output of given signal conditioning circuit.	VI	02
24	Test the performance of Portable Data Acquisition System.	VI	02*
25	Troubleshoot of potentiometer.	VI	02
26	Troubleshoot of strain gunge.	VI	02
27	Troubleshoot of venture tube.	VI	02*
28	Troubleshoot of rotameter	VI	02
	Total		**56**

Note:

iii. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

iv. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safely measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20

f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to KrathwohPs "Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2ml year
- 'Characterizing Level' in 3rd year

6. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

S. No.	Equipment Name with Broad Specifications	PrO. s No.
1	Analog multi-meter: 0-1 OA, 0-600V, 0-IOMΩ	1,2,4,5
2	Digital multi-meter: 0-10A, 0-600V. 0-10MΩ	All
3	Dual trace CRO with probe: Bandwidth AC 10Hz -20MHz (-3dB). DC -20MHz (-3dB), XI0 Probe	6,7,8,9
4	Digital storage oscilloscope: Bandwidth 60MHz, Dual Channel	10,11
5	Function generator: Frequency Ranges: 0.1 Hz to 11 MHz Pulse and Ramp Aspect Ratio: 95:5	8,9,10
6	Spectrum analyzer: 9 kHz - 26.5 GHz	12
7	LVDT: Stroke range>e ±0.1 |±2.54|or available range	14
8	Strain gauge: Universal general- purpose strain gages	15
9	RTD and Thermocouple (any one type): Pt 100, Type K, Chrome! (+) Alumel(-).0tol260°C	16,17
10	Venturi tube: process temperatures between -20 "F and +350F (-30 °C and +175 °C), accuracy of ± 0.50% for standard meters and ± 0,25% for flow calibrated meters. Orifice plate and rpm meter: 30mm diameter	16,17
11	pH meter: Portable pH meter range from 0 to 14 resolution 0.1/0.001pH RS.232C output and supply Data connector cable, digital display with 0.001 pi **I** unit readability	22
12	Portable Data Acquisition System Specification: 24-bit ADC/ch, 4 analog voltage inputs, Powered by USB	23,24

7. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I Fundamental of electronics measurements	1a. Classify the given measuring instrument. 1b. Determine static and dynamic characteristics of the measuring instruments with the given data. 1c. Identify the standards for calibration of the given instrument with justification. 1d. Explain with sketches the generalized procedure for calibration of the given instrument	1.1 Fundamentals of electronic measurement: 1.2 Characteristics of measurement: statics and dynamics characteristics, error in measurement, types of error. 1.3 Standards of measurement 1.4 Calibration: Need and meaning of calibration
Unit-II Analog and Digital meters	2a. Determine resolution, sensitivity and accuracy of the given digital display. 2b. Convert the PMMC instrument into DC ammeter for the given range. 2c. Convert the PMMC instrument into DC voltmeter for the given range. 2d. Explain with sketches the working of given type of ohm meter, AC voltmeter. 2e. Prepare specification of the given instrument.	2.1 Indicating and display device: D Arsonval movement, PMMC , moving iron, LCD, LED 2.2 Analog and Digital meters: Type of analog and digital meters, voltmeter, ammeter, ohm meter, extension of measuring range of meters, applications of meters, Calibration of meters
Unit-III Oscilloscope, Function generator, and Spectrum analyzer	3a. Explain with sketches the working of the given blocks and type of oscilloscope. 3b. Explain with sketches the procedure to measure the given parameters using CRO. 3c. Describe the function of the given blocks of signal/function generator. 3d. Explain with sketches the procedure to test the given types of signals using the relevant type lest and measuring instrument. 3e. Select CRO/ DSO, analyzer and function generator for specified application with justification. 3f. Prepare specification for the given instrument.	3.1 CRO: Block diagram of CRO, CRT, vertical deflection system and horizontal deflection system, need of delay line, time base generator, amplitude and frequency measurement using CRO, Lissajous patterns for phase and frequency measurement, component testing using CRO, dual trace and dual beam CRO. 3.2 DSO: Block diagram of DSO, various function, and applications of DSO 3.3 Function generator: Block diagram of function generator, application of function generator, Spectrum analyzer: Block diagram of spectrum analyzer and its applications.
Unit-IV Sensors and Transducers	4a. Describe the function of the given block of instrumentation system with the help of suitable block diagram. 4b. Select relevant transducers for given application with justification. 4c. Differentiate the features transducers and sensors for the given quantity measurement. 4d. Explain with sketches the working principle of given type of thermal sensor.	4.1 Instrumentation System; Block diagram of instrumentation system, function of each block. 4.2 Sensors and Transducers: basic definition. difference, classification of sensors 4.3 Thermal, optical, magnetic and electric sensors. 4.4 Transducer: Need of transducer, types of transducer: Primary, secondary, active, passive, analog,

	4e. Select lite relevant transducer for the given range of displacement measurement with justification.	digital, resistive, capacitive, inductive (LVDT, RVDT), piezoelectric transducer, selection criteria of transducer. 4.5 DC Bridges: Wheatstone and Kelvin bridges. 4.6 AC Bridges: General AC Bridge, Capacitor comparison bridge, Inductance comparison bridge ,Maxwell bridge, Hey bridge, Schering bridge, Wein bridge and their applications such as Q factor & D factor measurement.
Unit-V Applications of sensors and transducers	5a. Explain with sketches the working principle of the given transducers. 5b. Select suitable transducer for the given level measurement with justification. 5c. Select the relevant sensor for the given range of temperature measurement with justification. 5d. Select the relevant transducer for the given range of pressure measurement with justification 5e Select the relevant sensor/ transducer for the specified.	5.1 Level measurement: Need of level measurement, float type, capacitive type, ultrasonic type, radiation type, working principle, construction of each. 5.2 Temperature measurement: thermistor, RTD (Pt-100), thermocouple: see back and Peltier effects(J,K,R,S,T types),optical pyrometer 5.3Pressure measurement: Types, Bourdon tube, Bellows, Diaphragm, pressure measurement using Bourdon tube and LVDT 5.4 Flow measurement: types, Variable head flow meter: Venturi meter, orifice plate meter, Variable area flow meter: Rotameter, electromagnetic How meter, ultrasonic flow meter 5.5 Special transducers and measurement: Humidity measurement using hygrometer, pH measurement
Unit-VI Signal Conditioning	6a. Explain the need of sigma conditioning for the given measurement. 6b. Differentiate between the given block of ac and DC signal conditioning circuits.. 6c. Describe function of the given block of DAS. 6d. Explain with sketches the working of data acquisition system for the specified application.	6.1 Signal conditioning: need of signal conditioning. Types of signal conditioning: Block diagram of AC and DC signal conditioning circuits 6.2 Data acquisition system (DAS): Type of DAS, Application of DAS with example. 6.3 Testing of Components - Testing of Active & Passive components, common failures of various components system of units.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamental of electronics measurements	08	02	02	04	8
II	Analog and Digital meters	14	02	06	06	14
III	Oscilloscope Function generator and Spectrum analyzer	14	02	04	08	14
IV	Sensors and transducers	10	02	04	06	12
V	Applications of sensor and transducers	12	02	04	06	12
VI	Signal conditioning and Data acquisition system	06	02	02	06	10
Total		**64**	**12**	**22**	**36**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment o f UOs. The actual distribution o f marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of (he various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

i. Prepare the survey report on the applications of different types of number system and code converters used in the design of digital system.
j. Compare technical specifications and applications of various types of memory, PLDs, CPLDs and Prepare report.
k. Test digital **ICs** using various testing equipment like digital **IC** tester. Digital multimeter etc.
l. Give seminar on any course relevant topic.
m. Conduct library / internet survey regarding different data sheet and manuals.
n. Prepare power point presentation on digital circuits and their applications.
o. Undertake a market survey of different digital ICs required for different applications.
p. Search for video / animations / power point presentation on internet for complex topic related to the course and make a presentation.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

o. Massive open online courses ***(MOOCs)*** may be used to teach various topics/sub topics.
p. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
q. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations.
r. With respect to item No. 9, teacher need to ensure create opportunities and provisions for ***co-curricular activities.***
s. Guide student(s) in undertaking micro-projects.
t. PPTs/Animations may be used to explain the construction and working of electronic circuits.
u. Guide students for using data sheets / manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.*** The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. **Analog and digital meters:** Build and test voltmeter (0-10V, 1mA, 500Ohms) using PMMC.
b. **Analog and digital meters:** Build and test ammeter (0-100 mA) using PMMC.
c. **Signal conditioning:** Design D.C. signal conditioning circuit using Wheatstone bridge and implement that on PCB.
d. **Function Generator:** Build and Test function generator using IC 8038(sine wave, square wave, triangular wave up to **1**00 kHz) on the PCB.
e. **Oscilloscope Function generator, Spectrum analyzer:** Survey of different electronic instruments.
f. (Use structure and other features of 'Electronic Measurement and Instrumentation' to develop above listed applications).

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Modern Electronic Instrumentation and Measurement Techniques	Helfrick, A. D. Cooper, W.D.	Pearson Eduction India, 1st Edition, New Delhi, 2015 ,ISBN-13: 9789332556065
2	Electronic Instrumentation	Kalsi, H.S.	McGraw Hill, New Delhi,2010 ISBN: 13-9780070702066
3	Electronic Instrumentation and Measurements	David, A. Bell	Oxford University Press. New Delhi,2013, ISBN: 10:0-19-569614-X
4	Electrical and Electronic Measurements and Instrumentation	Sawhney, A. K.	Dhanpat Rai & Sons, New Delhi ,2005, ISBN: 13-9788177000160

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.mykIassroom.com/Engineering.../Electronics-&-1nstrumentation-Engg.-(EIE)
b. www.en.wikipedia.org/wiki/List_of_electrical_and_electronic_measuring_equipment
c. www.en.wikipedia.org/wiki/Electronic_test_equipment
d. www.en.wikibooks.org/wiki/Electronics/Measuring_Instruments

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Third
Course Title : Principles of Electronics Communication
Course Code : 21D35

1. RATIONALE

In the twenty-first century digital verbal exchange performs a vital function in each issue of human lifestyles. Diploma students (also known as technologists) should cope with the numerous electronic conversation circuits whilst preserving electronic conversation structures. The examination of fundamental operating principles and handling of diverse electronics communication system will assist them to troubleshoot and keep electronics communication systems used for diverse sort of communication. This path is developed in one of these ways that, students will be capable of observing the area information to remedy extensive conversation engineering software issues in a digital communication engineering subject.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Principle of Electronics Communication

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with **the above-mentioned competency:**

a. Use relevant frequency range for different communication systems.
b. Use relevant modulation technique for the specified application.
c. Maintain transmitter and receiver circuits of AM and FM.
d. Use relevant media for transmission and reception of signals.
e. Use relevant type of antenna for various applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory						Practical							
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	6	3	70	2S	30*	12	100	40	25	10	25	10	50	20	

(*): Under the theory PA, out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.
Legends: L-Lecture; **T -** Tutorial/Teacher Guided **Theory** Practice; **P -** Practical; **C** - Credit, **ESE - End** Semester Examination; **PA** - Progressive Assessment

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

DEPM	Semester III

S. No.	Practical Outcomes (PrOs)	Unit' No.	Approx. Hrs. Required
1	Use simple wires, switches and LEDs to establish simplex and half duplex communication link	I	02
2	Use simple wires, switches and LEDs to establish full duplex communication link	I	02
3	Observe the AM modulated waveforms generated for different carrier frequencies.	II	02
4	Generate AM wave and measure its modulation index.	II	02*
5	Use any simulation software to generate AM wave.	II	02
6	Use voltage-controlled oscillator to generate FM wave and measure the frequency deviation.	II	02
7	Generate FM wave and measure its modulation index.	II	02
8	Use any simulation software to generate FM wave.	II	02*
9	Use AM demodulator circuit to detect the received AM signal.	III	02*
10	Use IC 566 to generate FM waveform and measure modulation index	III	02
11	Use IC 564 / IC 565for FM demodulation and trace it's input and output waveforms.	III	02
12	Use any simulation software to measure 1. MUF for the given critical frequency and incident angle. 2. Radio horizon for given height of transmitting and receiving antenna	IV	02*
13	Use field meter to plot the radiation pattern of the given dipole antenna.	V	02*
14	Use field meter to plot the radiation pattern of given Yagi-Uda antenna.	V	02
15	Use any simulation software to plot radiation pattern of the given type of antenna.	V	02
Total			**30**

Note

i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
S. No.	**Performance Indicators**	**Weightage in %**
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20

6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in I$^{s'}$ year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S-No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Cathode Ray Oscilloscope Dual Trace 20Mhz,) Mega Ω Input Impedance	3 to l2
2	RF signal generator with Wide frequency range 100 KHz to 150 MHz Fine frequency adjustment by calibrated dial built in audio frequency generator	3 to l2
3	DSO with Bandwidth: 50/100MHz TFT Color LCD Dual Channel Real Time Sampling: 1 G Sa/s Equivalent Sampling 25GSa/s Memory 1M pts 10 Waveforms & 10 Setups can be stored	3 to 2
4	Regulated power supply: DC Supply Voltages Dual DC: 2 x 0 - 3OV;0-2A Automatic Overload (Current Protection) Constant Voltage & Constant Current Operation	1-12
5	AM trainer kit for DSB/SSB AM modulation and demodulation	3,4
6	Digital Multimeter: 3 1/2-digit display, 9999 counts digital multimeter measures: V_{ac}, V^ (1000V max) , A_{dc}, A_{ac} (10-amp max), Resistance (0 - 100 MC2), Capacitance and Temperature measurement	3 to l2
7	FM trainer kit for FM modulation and demodulation	3
8	Trainer kit for FM modulator using IC566: AC Source: 600Hz to 2.5 KHz FM Modulator: VCO Test Points circuits engraved on front panel with transparent rear panel	6.7.10, 11
9	Trainer kit for FM demodulator using IC 564: AC Source**:** 600Hz to 2.5 KHz.FM Demodulator :PLL Test Points	12
10	Antenna trainer kit: for dipole and yagi-uda antenna, mobile antenna, omnidirectional antenna, horn antenna and other common type of antennas	14,15
11	Software for program : SCILAB.MATLAB ,TINA PRO.	5,8,13,16
12	Simulation software suitable for communication experiments .	5,8, 13,16

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit -1 Basics of Electronic Communication	1 a. Interpret the working of the given block of basic electronic communication system. 1b .Identify the relevant frequency band of electromagnetic spectrum for the specified application with justification. 1 c. Compare features of the given types of transmission modes. Id, Differentiate properties of the given types of noise.	1.1 The elements of basic electronic communication system 1.2 Electromagnetic spectrum 1.3 Transmission modes: Simplex, half duplex and full duplex, Synchronous and Asynchronous 1.4 Sources of Noise (internal and external), signal to noise ratio
Unit- I I AM and FM Modulation	2a. Interpret necessity of the given type of modulation technique . 2b.Compare the working of the given type of AM generation technique. 2c. Describe with sketches the given parameters of AM signal. 2d. Calculate modulation index and power distributions of the given AM signal. 2e. Describe with sketches the specified parameters of FM and PM signal. 2f. Determine the modulation index of given FM signal.	2.1Need for modulation 2.20Types of modulation techniques Amplitude Modulation: Mathematical representation of amplitude modulated wave, modulation index, bandwidth requirement, representation of AM signal in time and frequency domain, types of AM with respect to frequency spectrum (DSB, SSB and VSB), Power relations in AM wave 2.3 Frequency Modulation: representation of FM signal in time domain and frequency domain , frequency deviation ratio, modulation index**(P),** mathematical representation of FM, bandwidth requirement, types of frequency modulation (NB and WBFM) 2.4 Phase Modulation
Unit- III Transmitters and Receivers	3a. Explain with sketches the working of the given type of AM generation technique. 3b.Explain the function of the given blocks of AM super heterodyne receiver. 3c. Explain with sketches the given types of AM demodulation technique. 3d. Explain with sketches principle of the given type of FM generation technique. 3e. Compare the working of the given types of FM detectors.	3.1 Generation of AM 3.2 Block diagram of AM super heterodyne receiver and its working with waveforms 3.3 Demodulation of AM signal: Diode detector and practical diode detector 3.4 Automatic gain control and its types. 3.5 Concept of pre-emphasis and De-emphasis 3.6 Generation of FM using direct (varactor diode and reactance modulator) and indirect method (Armstrong method) 3.7 Block diagram of FM receiver and its working with waveforms 3.8 FM detector circuits: Ratio detector and PLL as FM demodulator
Unit-IV Wave Propagation	4a. Describe the properties of the given types of electromagnetic waves. 4b. Describe with sketches propagation mode of the type of radio wave	4.1 Concept of propagation of radio waves 4.2 Ground Wave propagation Sky wave: Ionospheric layers, Concept of actual height and virtual height, critical frequency, skip

	4c. **Describe properties of the** specified Ionospheric layer. 4d. Explain parameters and properties of the given types of wave propagation. 4e. For the given application, identify the type of wave propagation to be used with justification.	distance. skip zone, concept of fading, maximum usable frequency, multiple hop sky wave propagation 4.2 Space Wave propagation: line of sight, multipath space wave propagation , optical and radio horizon, shadow zones 4.3 Duct propagation (microwave space-wave propagation) 4.4 Troposphere scatter propagation.
Unit- V Antennas	5a. Explain with sketches the working principle of the given type of antenna. 5b.Compare with sketches working of the given type of antenna on the basis of radiation pattern. 5c. Explain antenna parameters of the given type of antenna. 5d. Choose type of antenna required with broad specification for the given applications.	5.1 Antenna fundamentals :Resonant antenna and Non-resonant antennas 5.2 Antenna parameters : Radiation pattern, polarization, bandwidth, beamwidth, antenna resistance, directivity and power gain, antenna gain 5.3 Dipole antenna: Half wave dipole antenna (Resonant Antenna) and its Radiation pattern. Folded dipole antenna and its radiation pattern, Radiation pattern for Dipole Antenna of different length 5.4 Loop antenna. Telescopic antenna, Yagi-Uda antenna. Micro wave antenna - Dish antenna. Horn antenna and Micro-strip patch antenna .rectangular, square and circular (Structure, radiation pattern and application of antennas)

Note: To** attain the COs and competency, above listed UOs need to be undertaken to achieve **the 'Application Level' and above of Bloom**'s **'Cognitive Domain Taxonomy'.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Electronic Communication	08	4	4	4	12
II	AM and FM Modulation	16	4	**6**	8	18
III	Transmitters and Receivers	16	2	6	6	14
IV	Wave propagation	10	4	4	6	14
V	Antennas	14	4	**4**	4	12
Total		**64**	**18**	24	28	70

Legends: R^ Remember, U=Understand. A-Apply and above (Bloom's Revised taxonomy) Note:
*This specification table provides genera! guidelines to assist student for their learning and to teachers to leach and assess students with respect to attainment o f UOs. The actual distribution o f marks at different taxonomy levels (o f R, U and A) in the question paper may **vary** from **above table.***

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare chart for electromagnetic spectrum.

b. Give seminar on any relevant topic related to electronic communication medium.
c. Library survey regarding different communication books and manuals.
d. Prepare power point presentation for recent communication applications.
e. Undertake **a** market survey of different communication devices.
f. Visit radio transmitter station.
g. Visit auditorium near your campus and make layout of PA system.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses *(MOOCs)* may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities.*
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice,
g Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.
i. Arrange visit for students to make clear certain communication concepts.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three.*

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each project should encompass two or more COs which are in fact, an integration of POs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. **Modulation:** Build a circuit for modulation using IC MC1496/8038 on general purpose PCB and prepare the report.
b. **FM transmitter:** Build a circuit on general purpose PCB for FM transmitter using IC 8038/ transistor BF549 and prepare a report.
c. Find **different channels frequencies** associated with Am and FM stations.
d. **Antenna: Simulate a microstrip patch antenna for frequency 2.4GHz frequency using HFSS (high frequency structure simulator) software.**
e. **Tuning of IFT:** Build a circuit on general purpose PCB for tuning 1FT at 455KFIz

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic communication system: Fundamentals Through Advanced	Tomasi **W.**	Pearson Education India, New Delhi, 4lh Edition, 2001, ISBN: 9780130221254
2	Audio and video systems principals, maintenance and troubleshooting	Gupta R.G.	Tata McGraw Hill, New Delhi, 2010, ISBN : 9780070699762
3	Principles of Electronics Communication system	Frenzel Louis E.	Mc-Graw Hill 5lh" Edition, New Delhi,2007, ISBN : 9780073222783
4	Antenna Theory: Analysis and Design	Constantine A. Balanis	Wiley-Student edition India, New Delhi, 2015-16, ISBN: 9788126524228
5	Electronic Communication Systems	Kennedy George; Davis Bernard; Prasanna SRM	Mc-Graw Hill 5th Edition, New Delln',2011, ISBN : 9780071077828

13. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.antenna-theory.com/basics/main.php
b. www.explainthatstuff.com/antennas.html
c. www.circuitdiagram.org/am-radio-receiver-with-mk484.html
d. www.circuitstoday.com/single-chip-fm-radio-circuit

National Institute of Electronics & Information Technology, Aurangabad

Teaching and Examination Scheme for Diploma in Electronics Production and Maintenance

Program Name: Diploma in Electronics Production and Maintenance

Program Code: DEPM — **With Effect from Academic Year: 2021-2022**

Duration of Program: 6 Semesters — **Duration: 16 Weeks**

Semester: Fourth

Sr. No	Course Title	Abbreviation	Sub. code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory							Practical					
				L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
									Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
1	Linear Integrated Circuit	LIC	21D41	4	-	2	6	3	70	28	30	12	100	40	25	10	25	10	50	20	150
2	Consumer Electronics	CEL	21D42	3	-	2	5	3	70	28	30	12	100	40	25	10	25	10	50	20	150
3	Microcontroller and Applications	MIC	21D43	4	-	2	6	3	70	28	30	12	100	40	25	10	25	10	50	20	150
4	Power Electronics	PEL	21D44	3	-	2	5	3	70	28	30	12	100	40	25	10	25	10	50	20	150
5	Digital Communication Systems	DCS	21D45	4	-	4	8	3	70	28	30	12	100	40	25	10	25	10	50	20	150
6	Maintenance of Electronics Equipment and EDA tool Practices	MEDA	21D46	-	-	4	4	-	-	-	-	-	-	-	25	10	25	10	50	20	50
Total				**18**	**0**	**16**	**34**	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Student Contact Hours Per Week: 34 Hrs. Medium of Instruction: English

Theory and practical periods of 60 minutes each.

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

- Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

For the courses having ONLY Practical Examination, the PA has two parts, marks for : (1) Practical Part - 60% of total marks (ii) Micro-Project Part - 40% of total marks.

- Candidate remaining absent in practical examination will be declare as Absent in Mark List and has to reappear for examination. The marks of the part for which candidate was present will not be processed or carried forward.

DEAN ACADEMICS
NIELIT, Aurangabad.

Head
Department of Electronics
Dr Babasaheb Ambedkar Marathwada University
Aurangabad 431004

Associate Professor
Dept. of Electronics & Tele. Engg.
Govt. College of Engineering, Aurangabad.

कार्यकारी निदेशक
Executive Director

Institute of Electronics & Information Technology ★ NIELIT Aurangabad (MS)

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Fourth
Course Title : Linear Integrated Circuit
Course Code : 21D41

1. RATIONALE

IC technology needs the basics of Integrated Circuits for college kids regarding the appliance and special function ICs. The elemental knowledge about electronic components for successful handling of commercial problems. Operational Amplifier (Op-Amp) is that the most versatile Linear microcircuit (IC) wont to develop various applications in electronic circuits and equipment. Hence this course is meant to develop the talents to create, test, diagnose and rectify the Op-Amp based electronic circuits. This course deals with various aspects of Linear Integrated circuits utilized in various industrial, consumer and domestic applications.

2. COMPETENCY

The aim of this course is to assist the scholar to achieve the subsequent industry identified competency through various teaching learning experiences: Maintain electronic circuits consisting of Linear Integrated Circuits.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills related to this course are to be taught and implemented, in order that the scholar demonstrates the subsequent industry oriented COs related to the above mentioned competency:

a. Use op-amp in linear circuits.
b. Use various configurations of Op-Amp for different applications.
c. Troubleshoot various linear applications of Op-Amp for the given specifications.
d. Maintain filters and oscillators used in various electronic circuits.
e. Troubleshoot specified applications using various linear ICs.
f. Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve engineering problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				Examination Scheme													
				Theory							Practical						
L	T	P	Credit (L+T+P)	Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	6	3	70	28	30	12	100	40	25	10	25	10	50	20	

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the Cos. Legends: L-Lecture; T— Tutorial/Teacher Guided Theory Practice; P -. Practical; C — Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

Sr. No.	Tutorials	Unit No.	Approx. Hrs. Required
1	Use relevant instruments to measure the differential input resistance, input offset voltage, and Output offset voltage and common mode rejection ratio (CMRR) of IC741.	I	2
2	Measure the Output voltage Swing parameter of Op-Amp IC 741.	I	2
3	Use relevant instruments to determine gain of the Inverting amplifier and Non Inverting amplifier consist of 1C741.	II	2
4	Build/ Test adder and subtractor circuit consist of IC 741	II	2
5	Build/Test Integrator circuit consist of IC741	II	2
6	Build/Test differentiator circuit consist of IC741.	II	2
7	Build/Test Voltage to Current converter and Current to Voltage converter circuit consist of IC 741.	III	2
8	Build/Test comparator circuit consist of IC741 as Zero crossing detector and active positive peak detector.	III	2
9	Build/Test Instrumentation amplifier circuit using IC LM324.	III	2
10	Use relevant instruments to measure the bandwidth and cutoff frequency of the given first order low pass Butterworth filter.	IV	2
I I	Use relevant instruments to measure the bandwidth and cutoff frequency of the given first order high pass Butterworth filter.	IV	2
12	Use relevant instruments to measure the cutoff frequency of the given notch filter.	IV	2
13	Use relevant instruments to measure the frequency of oscillation of the given RC Phase shift oscillator circuit using IC741.	IV	2
14	Measure the frequency of oscillation of the given wien bridge oscillator circuit using IC741.	IV	2
15	Build/Test astable multi-vibrator using IC555 for the given specifications.	V	2
16	Build/Test mono-stable multi-vibrator using 1C555 for the given specifications.	V	2
Total			**32**

Note: -

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as `*' are compulsory, so that the student reaches the 'Precision Level' of Dave 's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

Sr. No.	Performance Indicator	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20

3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
TOTAL		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

a) Follow safety practices.
b) Practice good housekeeping.
c) Demonstrate working as a leader/a team member.
d) Maintain tools and equipment.
e) Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs, Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in lst year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED –

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

Sr. No	Equipment Name with Broad Specifications	Exp. S. No.
1	Variable DC power supply 0- 30V, 2A	ALL
2	Cathode Ray Oscilloscope Dual Trace 30Mhz, 1MegaQ Input Impedance	2,3,5,6,8,9,10, 11,12,16,
3	Digital Storage Oscilloscope 25MHz/40MHz/60MHz/100MHz bandwidth,5OOMS/s to 1 GS/s real time sample rate.	2,3,5,6,8,9,10, 11,12,13,14,15 ,16
4	Function Generator 0-2 MHz with Sine , square and triangular output with variable frequency and amplitude range.	2,3,5,6,8,9,10, 11,12,13,14,15 ,16
5	Digital Multimeter : 4 1/2 digit display, 9999 counts digital multi meter measures: V11 C, V^ (1000V max), Adc, Aac (10 amp max)\, Resistance (0-100 MQ)	ALL
6	Electronic Work Bench : Bread Board 840 1000 contact point, Positive and Negative power rails on opposite side of the board, connecting wires,	ALL

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency, More UOs could be added.

Unit	Unit Outcomes (UOs) in cognitive domain)	Topics and Sub-topics
Unit-I Fundamentals of Operational Amplifier (Op -Amp)	1.a Describe with sketches the function of the given block(s) of the Op-Amp. 1b. Select the parameters to be considered for the given applications of the Op-Amp with justification. 1c. Explain with sketches the working of the given type of Op-Amp configuration. ld. Describe with sketches the procedure to troubleshoot the given Op-Amp circuit.	1.1 Operational Amplifier, Equivalent Circuit, Circuit symbols and Terminals. 1.2 Op-Amp IC 741 pin diagram and pin function; Op-Amp parameters: Input offset voltage, Input offset current, Input bias current. Differential input resistances, input capacitances, input voltage range, offset voltage adjustment range, common mode rejection ratio (CMRR), supply voltage rejection ratio, slew rate, large signal voltage range, supply voltage, supply current, Current, Output voltage Swing, Gain Bandwidth Product, Output Short Circuit Current. 1.3 Transfer Characteristic- Ideal and Practical Voltage Transfer Curve. 1.4 Op-Amp Configuration: Open Loop and Closed loop. 1.5 Virtual Ground Concept.
Unit- II Applications of Operational Amplifier	2a. Explain with sketches the working of the given types of modes of Op-Amp operation. 2b. Calculate the output voltage of the given arithmetic circuit consist of Op-Amp. 2c. Select the relevant Op-Amp configuration for the given application with justification. 2d. Calculate the given parameter for the specified Op-Amp configuration.	2.1 Closed Loop configuration, modes of operations: Inverting and Non-Inverting. 2.2 Differential amplifier, Unity Gain Amplifier (voltage follower). 2.3 Arithmetic operations: Addition, Scaling, Averaging, Subtraction Integrator, Differentiator. 2.4 Concept of frequency compensation of Op-Amp and offset nulling.

Unit- III Linear Applications of Op-Amp	3a. Explain with sketches the working of an Instrumentation amplifier for the given application. 3b. Choose relevant Op-Amp converter for the given applications with justification. 3c. Select the Op-Amp based comparator for the given application with justification. 3d. Explain with sketches working of Op-Amp for the given application.	3.1 Op-Amp as an Instrumentation amplifier: Working, Derivation of output voltage, IC LM 324- Pin Configuration, specification and application. 3.2 Voltage to Current converter with Floating and Grounded load. 3.3 Current to Voltage converter. 3.4 Sample and Hold Circuit 3.5 Logarithmic and Antilogarithmic amplifier using diodes. 3.6 Analog Divider and analog multiplier. 3.7 Comparators: IC LM710 a. Zero Crossing Detector b. Schmitt Trigger c. Window Detector d. Phase Detector e. Active Peak Detector f. Peak to Peak Detector
Unit-IV Filters and Oscillators	4a. Explain working of the given type of filter with sketches. 4b. Explain with sketches procedure to identify the given type of filter based on frequency response. 4c. Calculate cut-off frequency for the given type of filter. 4d. Prepare the specifications of the given type of filter with justification. 4e. Explain with sketches the working principle of the given type of oscillator. 4f. Determine the frequency of oscillation of the given type of oscillator with frequency Response. 4g. Describe with sketches the procedure to troubleshoot the	4.1 Filter and its classification. 4.2 Merits and demerits of active filters over passive filters. 4.3 Filter characteristic terms order of filter, cut off frequency Pass band. Stop band, Centre frequency, Roll off rate, Bandwidth, Q factor. 4.4 Filter types and its Frequency Response: Low pass (First Order and second order), High Pass (First Order and second order), Band pass (Wide and Narrow), Band Reject (Wide and Narrow), All Pass Filter. 4.5 Oscillator types using IC 741: Phase shift oscillator, Wein Bridge oscillator, Colpitts oscillator, Hartley oscillator.

Unit -V Specialized IC Applications	5a. Explain with sketches the working of IC555 for the given application. 5b. Calculate the duty cycle of the given type of multivibrator. 5c. Explain with sketches the working of the given blocks of PLL. 5d. Calculate lock range and capture range of the given PLL. 5e. Describe with sketches the procedure to troubleshoot the given circuit with IC.	5.1 IC 555: Block Diagram of Timer, Pin Diagram and functions, Astable. Monostable, Bistable multivibrator. Schmitt trigger and Voltage Control Oscillator. 5.2 Phase Lock Loop (PLL): Block diagram and its operation, lock range and capture range. 5.3 Applications of PLL: PLL as a Multiplier, FM Demodulator. 5.4 IC 565: Pin diagram and function.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level ' and above of Bloom's 'Cognitive Domain Taxonomy

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Operational	10	2	2	4	8
II	Applications of Operational Amplifiers	10	2	4	6	12
III	Linear Applications of Op-Amp	18	2	6	12	20
IV	Filters and Oscillators	16	2	6	10	18
V	Specialized IC Applications	10	2	4	6	12
Total		**64**	**10**	**22**	**38**	**70**

Legends: R=Remember, U=Understand, A—Apply and above (Bloom's Revised taxonomy) Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs, The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare journals based on practical performed in laboratory.
b) Follow the safety precautions.
c) Use various meters to test electronic equipment and component

d) Use datasheets of various Linear ICs.
e) Library /Internet survey of Op-Amp based linear circuits and their applications.
f) Prepare power point presentation or animation for understanding different Op-Amp based circuit behavior.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses *(MOOCs)* may be used to teach various topics/sub topics.
b) *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c) About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d) With respect to item No. 9, teachers need to ensure to create opportunities and provisions for *co-curricular activities.*
e) Guide student(s) in undertaking micro-projects.
f) Demonstrate students thoroughly before they start doing the practice.
g) Encourage students to refer different websites to have deeper understanding of the subject.
h) Observe continuously and monitor the performance of students in Lab.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project AW group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three.* The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty

a) Build Instrumentation Amplifier (IC LM324) for measurement of temperatures using thermocouple/RTD/Thermistor.
b) Develop sound sensor using LM324 and microphone.
c) Develop a shadow sensor circuit using IC741.
d) Develop a temperature control dc fan using IC 741.
e) Develop a remote control for switching devices (use IC 555 and TSOP 1738).
f) Develop sequential timer circuit using multiple timers.

g) Develop clap switch using op-amp.
h) Develop water level controller using IC555.
i) Develop a tone generator using IC 555.
j) Develop PWM LED Dimmer/ Brightness Control using 1C555.
k) Build frequency synthesizer using PLL IC565.
l) Develop FSK modulator and demodulator using PLL IC565
m) Simulate using software LT spice/ P-spice / Scilab/ Matlab /Octave or any other open-source software linear IC applications

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Op-Amps and Linear Integrated Circuits	Mottershead. Allen	PHI Learning, New Delhi, ISBN 9788120301245
2	Electronic Devices and Circuit Theory	Boylestead Robert, Louis Neshelsky	Pearson Education.] Orn edition. New
3	The Art of Electronics	Paul Horowitz Winfield Hill	Delhi,2009, ISBN: 978-8131727003
4	Electronics Principles	Albert Paul Malvino, David J. Bates	Cambridge University Press, No. Delhi 2017 ISBN: 0070634246 · 9780070634244
5	Principles of Electronics	Mehta, V.K. Mehta. Rohit	McGraw Hill Eduction, NeiN Delhi. ISBN: 978-0070634244
6	Basic Electronic Engineering	Baru V_. Kaduskar R.,Gaikwad S.T,	S Chand and Company, Ram Nagar, New Delhi-
7	Fundamentals of Electronic Devices and	Bell, David	9788121924504
8	A text book of Applied Electronics	Sedha, R S	Dreamtech Press, New Delhi, 2015 ISBN: 9789350040126

13. SOFTWARE/LEARNING WEBSITES

a) IC555 :-http://www.jamia-physics.net/lecnotes/lab/555.pdf
b) IC 555 data sheet:-http://www.electroschematics.com/650/lm555-datasheet/
c) Op-Amplifier basics:-https://www.khanacademy.org/science/electrical-engineering/ee-amplifiers.
d) Data sheet555:-www.engineersgarage.com/electronic-components/ne555-timer-ic-datasheet.
e) Vide lecture Op-Amp:-http://freevideolectures.com/Course/3062/El^ctronics-I/37.
f) Voltage control Oscillation- http://www.electronicshub.org/voltage-controlled-oscillators-vco/

Program Name : Diploma in Electronics Production & Maintenance
Program Code : DEPM
Semester : Fourth
Course Title : Consumer Electronics
Course Code : 21D42

1. RATIONALE

The objective of teaching this subject is to offer students an thorough knowledge of varied electronic audio-video, microwave , washer , air-conditioner, camcorder et al. to develop skills to troubleshoot in systematic way knowledge so gained would also help in production units of those consumer gadgets or help the scholars to start out their own enterprises. Further this subject will introduce the scholars with working principles, diagram , main features of consumer electronics gadgets/goods/devices. This in-turn will develop in them capabilities of assembling, fault diagnosis and rectification during a systematic way. In developing Nations demand of consumer electronic appliances is increasing day by day. this needs sizable amount of technically trained man power within the relevant industries. Looking towards this need, in-depth knowledge for maintaining various consumer electronics appliances/equipment is important for diploma engineering pass out students.

2. COMPETENCY

The aim of this course is to assist the scholars to achieve the subsequent industry identified competency through various teaching learning experiences: Maintain various consumer electronic appliances/equipment.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills related to this course are to be taught and implemented, in order that the scholar demonstrates the subsequent industry oriented COs related to the above mentioned competency:

a) To identify the various digital and analog signal.
b) Describe various safety standards use in consumer electronics appliances
c) Troubleshoot different types of microphones and speakers.
d) Understand the principal and application of home appliances.
e) Maintain audio systems.
f) Analyze the composite video signal used in TV signal transmission.
g) Troubleshoot color TV receivers.
h) Maintain various consumer electronic appliances.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				**Examination Scheme**													
			Credit	**Theory**								**Practical**					
L	**T**	**P**	**(L+T+P)**	**Paper Hrs.**	**ESE**		**PA**		**Total**			**ESE**		**PA**		**Total**	
					Ma	**Min**	**Ma**	**Min**	**Ma**	**Min**		**Ma**	**Mi**	**Max**	**Min**	**Ma**	**Mi**

					x		x		x		x	n			x	n
3	-	2	5	3	70	28	30	12	100	40	25	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs, Legends: L-Lecture; T— Tutorial/Teacher Guided Theory Practice; P -. Practical; C Credit ESE - End Semester Examination; PA Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Test the performance of the given Microphone.	I	02
2	Test the performance of the given speaker.	I	02
3	Test output voltage and power of the Hi-Fi amplifier.	II	02
4	Identify any three different faults by voltage analysis method for Hi Fi Audio amplifier.	II	02
5	Select exact speed to write a CD for given type of data.	II	02
6	Install/Test the CD for given type of data.	II	02
7	Measure voltage levels to sketch composite video signal at different stages of TV receiver.	III	02
8	Use multi-meter to measure voltage at various test points of color TV receiver a) Chroma section b) Picture Tube.	IV	02
9	Use multi-meter to test various test points at Horizontal section of color TV receiver.	IV	02
10	Use multi-meter to test voltages at various points of vertical section of the color TV receiver.	IV	02
11	Suggest the remedy for the Created fault and in the given color TV trainer kit for the following faults a) No color b) Red color only c) Green color only e) No sound.	IV	02
1 2	Suggest the remedy for the following faults in given color TV a) Fault in HSYNC section b) Fault in VSYNC section.	IV	02
13	Suggest the remedy for the following faults in color TV a) Fault in SYNC separator b) Fault in video amplifier.	IV	02
14	Test the various sections of LED television receiver.	IV	02
15	Test the various sections of LCD television receiver.	IV	02
16	Test the various functions of Camcorder	IV	02
17	Test the various features of the given type of printer.	V	02
Total			**34**

Note: -

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as `*' are compulsory, so that*

the student reaches the 'Precision Level' of Dave 's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

Sr. No.	Performance Indicator	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices
b. Practice good housekeeping
c. Practice energy conservation
d. Demonstrate working as a leader/a team member
e. Maintain tools and equipment

The ADOs are not specific to any one PrO, but are embedded in many PrOs, Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in lst year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED –

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

Sr. No	Equipment Name with Broad Specifications	Exp. S. No.
	Digital Multimeter: 3.5 digit with R , V, I measurements.	All
	Cathode Ray Oscilloscope: Bandwidth : DC-30 MHz dual channel, Rise time: 12 ns approx Accuracy : ± 3 % Input	6,7,8
	Digital Storage Oscilloscope. Bandwidth : 50/100MHz TFT Color LCD Dual Channel Real Time Sampling: 1GS.	6,7,8
	Hi Fi amplifier system trainer.	3
	CD player trainer kit.	4
	Color TV receiver trainer kit.	5,6,7,8

7	LED television receiver trainer kit.	15
8	LCD television receiver trainer kit.	16
9	Color Pattern generator.	3-16
10	Camcorder.	17

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) in cognitive domain)	Topics and Sub-topics
UNIT-I Audio Fundamentals	1a. Differentiate between Mono & Stereo amplifier with respect to the given No. of speaker, No. of amplifiers, quality of sound & application. 1b. Describe the operating Principles of the given types of microphones. 1c. Select the microphone for the given application. 1d. Explain with sketches the working principle of the given type of speaker. 1e.Describe the troubleshooting procedure of the given Microphone/speaker system.	1.1 Basic characteristics of sound signal: level and loudness, pitch, frequency response fidelity, sensitivity and selectivity. 1.2 Audio Amplifiers: Mono, Stereo 1.3 Microphone: working principle, and characteristics, Types: carbon, condenser, crystal, electrets and tie clip 1.4 Speakers: working principle and characteristics, Types: electrostatic, dynamic, permanent magnet etc., woofers, tweeter and midrange, wireless. 1.5 Troubleshooting procedure
Unit-II Audio Systems	2a. Describe with sketches the given section of CD player. 2b. Explain with sketches the given mechanism of the give type of CD player with justification. 2c. Explain with sketches the Working of the given section of Hi Fi amplifier. 2d. Describe working of the given section of PA system. 2e. Describe the troubleshooting procedure of the given section of the audio system.	2.1 Block diagram and operation of CD player, types of CD player. 2.2 Component used for CD mechanism: CD pick-up assembly, gear system, drive motors, CD lens 2.3 Block diagram of Hi Fi amplifier and its working 2.4 Public Address (PA) system: Block diagram and operation, Speaker impedance matching and characteristics 2.5 Home theatre system 2.6 Troubleshooting procedure of audio systems. 2.7 Block diagram and working of MP3

Unit- III Television Fundamentals and Transmitter	3a. Explain with sketches the Given type of scanning process. 3b. Describe with sketches the features of the given component of composite video signal. 3c. Explain with sketches the concept of the given type of modulation used in TV signal transmission with justification. 3d. Explain with sketches the given block of color TV transmitter. 3e. Describe the troubleshooting procedure of the given section of the color TV transmitter.	3.1 Concept: Aspect ratio, image continuity, interlaces scanning, scanning periods - horizontal and vertical, vertical and horizontal resolution. 3.2 Vestigial sideband transmission, bandwidth for Colour signal, characteristics of colour signal, compatibility. 3.3 Colour theory, Grassman's law, additive and subtractive colour mixing Composite Video Signal - Pedestal height, Blanking pulse, colour burst, Horizontal sync pulse details, Vertical sync pulse details, equalizing pulses. 3.4 CCIR-B standards for colour signal transmission and reception, Positive and Negative modulation, merits and demerits of negative modulation 3.5 Block diagram of Colour TV Transmitter. 3.6 Troubleshooting procedure of Colour TV Transmitter.
Unit- IV Television Receivers	4a. Describe with sketches the function of the given block of a color TV receiver. 4b. Describe with sketches the function of the given section of PAL-D decoder. 4c. Compare the salient features of the given types of TV display. 4d. Explain with sketches the functions of the given block of DTH receiver. 4e. Describe the troubleshooting procedure of the given section of the color TV receiver.	4.1 Block diagram and Operation of colour TV receiver. 4.2 Operation of PAL-D decoder 4.3 HDTV: Development of HDTV, Nl MUSE System and NHK Broadcast 4.4 LCD/LED Technology: Principal working of LCD and LED TV. 4.5 Direct to Home Receiver (DTH): Concept, receiver block diagram, Indoor and outdoor unit. 4.6 Troubleshooting procedure of Colour.TV Receiver systems. 4.7 Block diagram and working of OLED. 4.8 Troubleshooting procedure of Colour TV Receiver systems.

Unit-V Consumer Electronic Appliances, Medical Electronics Equipment	5a. Explain with sketches the working of the given section of the photocopier machine with its specifications. 5b. Prepare specification of a Microwave oven for the specific applications. 5c. Explain with sketches the working of the given section of the given type of washing machine. 5d. Explain with sketches the working of the given type of Digital camera. 5e. Describe the troubleshooting procedure of the given office/ home appliances.	5.1 Photocopier block diagram, working. 5.2 Microwave Oven: types, single chip controllers, block diagram, types, and wiring and safety instructions, electrical specifications. 5.3 Washing Machine: Block diagram of washing machine, electrical Specifications, types of washing machine: Automatic, semi-automatic. 5.4 Digital camera and cam coder: pick up devices, picture processing, and picture storage electrical specification. 5.5 Study of Ventilators, ECG machine, Digital Thermometer.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level ' and above of Bloom's 'Cognitive Domain Taxonomy.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Audio Fundamentals	06	02	04	02	08
II	Audio Systems	08	04	04	04	12
III	Television Fundamentals and TV Transmitter	10	06	06	04	16
IV	Television Receivers	12	04	06	04	14
V	Consumer Electronic	12	04	04	12	20
Total		**48**	**20**	**24**	**26**	**70**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare the survey report on the specifications and applications of different types of Microphone and speaker.
b. Conduct market survey for latest home applications and compare specifications of reputed brands and prepare a report.
c. Make visit to service center of electronic gadgets.
d. Follow the safety precautions.
e. Use various meters to test electric/electronic equipment and component.
f. Library / Internet survey of electrical circuits and network.

g. Prepare power point presentation or animation for understanding different circuit's behavior.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b. (L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No. 9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Battery charger: Build a Battery charger for mobile phone. Prepare a report.
b. FM Radio Receiver: Build FM radio receiver using IC TEA5591.
c. Installation of DTH: Install DTH indoor and outdoor unit.
d. Up Down counter: Build a circuit for 2digit Up Down counter at gates of a mall/Parking space. Prepare a report.
e. Timer delay : Build a Timer delay using IC 89c51.
f. Gas leakage detector: Develop a circuit for LPG gas leakage detector. Prepare a report.
g. Smoke detector: Build a Smoke detector circuit for office/hospitals. Prepare a report.
h. Temperature controller: Temperature controller using microcontroller. Prepare a report.

i. Temperature controller: Temperature controller using microcontroller. Prepare a report.
j. Bar code reader: Build a Bar code reader circuit for super market/library.
k. PA system: Develop a PA system for small conference hall.
l. Light ON OFF control: Develop a circuit for Light ON OFF control using mobile app and Bluetooth. Prepare a report.

12. SUGGESTED LEARNING RESOURCES: -

Sr. No.	Title of Book	Author	Publication
1	Consumer Electronics	Bali, S.P.	Pearson Education India, Delhi, 2007; ISBN: 9332500738, 9789332500730
2	Audio video systems principles, maintenance and troubleshooting	Gupta, R.G.	McGraw Hill, New Delhi, India 2017, ISBN: 9780070699762
3	Audio video systems : principle practices and troubleshooting	Bali, Rajeev ; Bali, S.P.	Khanna Book Publishing Co. (P) Ltd., 2014 Delhi, ISBN:9788187522058
4	Modern Television Practice: Transmission, Reception and Applications	Gulati, R.R.	New Age International, New Delhi Year 2015, ISBN: 978-81-224¬3784-3
5	Television and video Engineering	Dhake, A.M	McGraw- Hill, New Delhi, India 2017, ISBN: 978-0074601051

13. SOFTWARE/LEARNING WEBSITES

a. Microphone:-https://www.coursehero.com/file/18404103/7-Microphonesppt/
b. Microwaveoven: www.calvin.edu/~pribeiro/courses/engr302/Samples/Microwave.ppt
c. Photocopier machine:www.youtube.com/watch?v=NxUbPE8RsiM
d. Television: https://www.slideshare.net/PravinShirke07/colour-television
e. Colour TV theory: https://www.slideshare.net/slhallman/color-theory-533704

Program Name : Diploma in Electronics Production & Maintenance
Program Code : DEPM
Semester : Fourth
Course Title : Microcontroller and Applications
Course Code : 21D43

1. RATIONALE

The study of microcontrollers in terms of architecture, software and interfacing techniques results in the understanding of working of microcontrollers and applications of microcontroller in electronic industries. Microcontroller is that the heart of the programmable devices. Microcontroller is employed in most the domestic, industrial, commodity and other high end products. Automation is employed in every field of engineering and microcontroller is inbuilt element of those systems and devices. Diploma engineers need to affect various microcontroller based systems and maintain them. This course is meant to develop the talents to take care of and solve the appliance problems associated with microcontrollers.

2. COMPETENCY

The aim of this course is to assist the scholars to achieve the subsequent industry identified competency through various teaching learning experiences:

- Maintain microcontroller-based systems.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills related to this course are to be taught and implemented, in order that the scholar demonstrates the subsequent industry oriented COs related to the above mentioned competency:

a. Analyze architecture of microcontroller ICs.
b. Understand the working of microcontrollers
c. Understand the Instruction set and programming related to microcontrollers
d. Interpret the program for 8051 in assembly language for the given operations.
e. Interpret the program by using timer, interrupt and serial ports /parallel ports.
f. Interface the memory and I/O devices to 8051 microcontroller.
g. Maintain microcontroller used in different application.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme				**Examination Scheme**													
			Credit	**Theory**							**Practical**						
L	**T**	**P**	**(L+T+P)**	**Paper Hrs.**	**ESE**		**PA**		Total		**ESE**		**PA**		**Total**		
					Max	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**
4	-	2	6	3	70	28	30	12	100	40	25	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs,

Legends: L-Lecture; T— Tutorial/Teacher Guided Theory Practice; P -. Practical; C — Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

ɾ. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify various blocks of 8051 microcontroller development board.	I	02
2	Write sample assembly language program using various addressing modes and assembler directives.	I	02
3	Write an assembly language program (AIP) to perform arithmetic operations addition, subtraction, multiplication and division.	II	02
4	Write an ALP to transfer data from source to destination location of internal/external data memory.	II	02
5	Write an ALP to find smallest/largest number from the given data bytes stored in internal/external data memory locations.	II	02
6	Write an ALP for arranging numbers in ascending /descending order stored in external memory locations.	II	02
7	Write an ALP to generate delay using register.	II	02
8	Write an ALP to transfer 8-bit data serially on serial port.	III	02
9	Interface LED with microcontroller and turn it ON with microcontroller interrupt.	III	02
10	Develop an ALP to generate pulse and square wave by using Timer delay.	III	02
11	Interface 4X4 LED matrix with 8051 to display various pattern.	III	02
1 2	Interface 7-segment display to display the decimal number from 0 to 9.	IV	02
13	Interface relay with microcontroller and turn it ON and OFF.	IV	02
14	Interface LCD with 8051 microcontrollers to display the character and decimal numbers.	IV	02
15	Interface the given keyboard with 805land display the key pressed.	IV	02
16	Interface ADC with 8051 microcontroller and verify input/output.	IV	02
17	Interface DAC with 8051 microcontroller and observe following waveforms: square wave, triangular wave, sawtooth wave.	IV	02
18	Interface stepper motor to microcontroller and rotate in clockwise and anti-clockwise direction at the given angles.	V	02
Total			**36**

Note: -

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as `' are compulsory, so that the*

student reaches the 'Precision Level' of Dave 's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

Sr. No.	Performance Indicator	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a) Follow safe practices.
b) Practice good housekeeping.
c) Practice energy conservation.
d) Demonstrate working as a leader/a team member.
e) Maintain tools and equipment.
f) Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs, Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in lst year.
- 'Organising Level' in 2nd year_
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED –

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

Sr. No	Equipment Name with Broad Specifications	Exp. S. No.
1	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery backup,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in power supply or any other equivalent	All
2	Desktop PC with microcontroller simulation software. Impedance : 1M ohm	All
3	Stepper Motor, 50/100 RPM	18

4	CRO- Bandwidth AC 10Hz ~ 20MHz (-3dB). DC ~ 20MHz (-3dB), XI0 Probe	17
5	Keyboard 4*4trainer board	15
6	Relay trainer board suitable to interface with 8051 trainer kit	13
7	4X4 LED matrix suitable to interface with 8051 trainer kit	15
8	7-segmenl LED Display:- 0.56 in 1-digit, common anode/common cathode	12
9	ADC (0808)trainer board	16
10	DAC (0808)trainer board	17
11	LCD trainer board	14

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs in cognitive domain)	Topics and Sub-topics
Unit -1 Basics of Microprocessor & 8051 Microcontroller	la. Compare salient features microprocessor, microcontroller and microcomputer for the given parameters. lb. Describe with sketches the function of the specified blocks of the given type of microcontroller architecture. lc. Explain with sketches memory organization of 8051 microcontroller. d. Compare the given derivatives of the 8051 microcontrollers. le. Describe with sketches the procedure to troubleshoot the simple given microcontroller-based circuit	1.1 Microprocessor, microcomputers, and microcontrollers (basic introduction and comparison). 1.2 Types of buses, address bus, data bus and control bus. 1.3 Harvard and Von-neuman architecture; 8051 microcontroller: Architecture, Pin configuration. stack, memory organization. 1.4 Boolean processor, saving options - idle power mode. 1.5 Derivatives of 8051 (8951, 8952 8031, 8751).

Unit-II **8051** **Instruction Set and programming**	2a. Identify the addressing mode of the given instruction. 2b. Describe the function of the given instruction with suitable examples. 2c. Write an assembly language program (ALP) for the given operation. 2d. Explain the function of the given software development tools. 2e. Explain the use of the given assembler directives with example.	2.1 Addressing modes 2.2 Instruction set (Data transfer, Logical, Arithmetic, Branching, Machine control, Stack operation, Boolean). 2.3 Assembly language programming (ALP) 2.4 Software development cycle: editor, assembler, cross-compiler, linker, locator, compiler. 2.5 Assembler Directives: ORG , DB , EQU , END,CODE,DATA
Unit III **8051 Timers, Interrupts , Serial and Parallel Communication**	3a. Write an ALP to generate a delay for the given crystal frequency for the specified waveform on the given port. 3b. Explain with sketch the operation of the given mode for timer and counter. 3c. Explain with sketch the operation of the given mode for serial communication. 3d. Generate the waveforms by using the given mode of timer. 3e. Describe with sketches the procedure to troubleshoot the simple given timer circuit.	3.1 Timer/Counters: SFRs: TMOD, TCON, Timer/Counter - Logic and modes, Simple programs on timer to generate time delay. 3.2 Interrupts-SFRs:- IE, IP , Simple programs on interrupts 3.3 Serial communication - SFRs: SCON, SBUF, PCON, Modes of serial communication. Simple programson serial communication. 3.4 I/O port structure and configuration - P0 , PI , P2 ,P3
Unit-IV **8051 Memory and I/O device Interfacing**	4a. Describe with sketch the interfacing of the given external memory. 4b. Explain with sketch the interfacing of the given external I/O device. 4c. Write an assembly language program to operate the given I/O device. 4d. Describe with sketches the interfacing diagram of the given ADC chip. 4e. Describe with sketches the procedure to troubleshoot the simple given I/O device.	4.1 Memory interfacing :-Program and data memory 4.2 I/O Interfacing: -LED, relays, keyboard, LCD, seven segment display, Stepper motor. 4.3 Interfacing DAC - 0808 with 8051 and its simple programming 4.4 Interfacing ADC - 0808/09 with 8051 and its simple programming.

Unit-V Applications of 8051 Microcontroller	5a. Generate the specified waveform using 8051 by the given method. 5b.Control the given parameter using 8051 microcontroller. 5c. Explain with sketch the given application which uses the specified microcontroller. 5d. Program 8051 for the given application. 5e. Describe with sketches the procedure to troubleshoot the simple given microcontroller-based application.	5.1 Square wave generation using port pins of 8051. 5.2 Square and triangular Waveform generation using DAC. 5.3 Water level controller. 5.4 Temperature controller using ADC (0808/09). 5.5 Stepper motor control for clock wise, Anti-clock wise rotation. 5.6 Traffic light con-roller

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level ' and above of Bloom's 'Cognitive Domain Taxonomy

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Microprocessor and 8051 Microcontroller	16	04	06	08	18
II	8051 Instruction Set and programming	12	02	04	06	12
III	8051 Timers, interrupts ,serial and parallel communication	14	04	04	08	16
IV	8051 Memory and I/O device Interfacing	12	02	04	06	12
V	Applications of 8051 Microcontroller	10	02	04	06	12
Total		**48**	**20**	**24**	**26**	**70**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Follow the safety precautions.
c. Give seminar on relevant topic.
d. Library/Internet survey regarding different data books and manuals.
e. Prepare power point presentation on applications of microcontroller.

f. Undertake a market survey of different microcontrollers.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses *(MOOCs)* may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No. 9, teachers need to ensure to create opportunities and provisions for *co-curricular activities.*
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the course.
h. Observe continuously and monitor the performance of students in Lab.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs. Micro project report may be of four to five page.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
b. Prepare a chart of stepper motor to display its features and steps for its operation using data sheets.
c. Prepare a chart of various features and operations of temperature sensors using data sheets.
d. Prepare a chart of various types of ADC and DAC to display its features and pin functions using data sheets.
e. Prepare a chart of various types of LCDs to display its features, pin functions and steps of operations using data sheets.

f. Prepare a chart of various types of seven segment displays, keyboard to display its features and steps for its operations using data sheets.
g. Build a circuit using 8051 microcontroller to blink LED.
h. Build a circuit using 8051 microcontroller to blink LED in ring fashion.
i. Build a circuit to turn the buzzer ON after 10 seconds,
j. Build a circuit to turn the buzzer ON after a key pressed,
k. Build a circuit to display number 0 to 9 with a given delay.
l. Build a class period bell using microcontroller.
m. Build a room temperature measurement circuit using microcontroller.
n. Build a circuit to generate square waveform using DAC and microcontroller.
o. Build stepper motor controller using microcontrollers.
p. Build traffic light controller for specified delay.
q. Build a water level controller for given parameters.
r. Identify the advanced microcontrollers such as raspberry-pi, Arduino
s. Build application based on advanced microcontroller such as raspberry-pi, Arduino

12. SUGGESTED LEARNING RESOURCES: -

Sr. No.	Title of Book	Author	Publication
1	8051 Microcontroller Architecture, Programming and Application	Kenneth J.Ayala	PHI Learning New Delhi,July 2005, ISBN: 978-1401861582
2	Microcontroller Theory and Application	Ajay V. Deshmukh	McGraw Hill, New Delhi, 2017, ISBN- 978-0070585959
3	Microcontrollers Principle and Application	Ajit Pal	PHI Learning,New Delhi, 2014, ISBN: 978-81-203-4392-4
4	The 8051 Microcontroller and Embedded system Using Assembly and C	Muhammad Ali Mazidi. Gillispie Mazidi.Roli, n D.Mckinlay Janice	Pearson /Prentice Hall,, 2nd edition, Delhi,2008, ISBN 978¬8177589030
5	Microcontroller Architecture Programming, Interfacing and System Design	Raj Kamal	Pearson Education, Delhi, 2012, ISBN:9788131759905
6	Microprocessors and Microcontrollers	Sunil Mathur, Jeebananda Panda	PHI Learning,NewDelhi, 2016, ISBN :978-81-203-5231-5
7	Architecture programming and System Design	Krishna Kant	PHI Learning New Delhi, 2016,ISBN:978-81-203

13. SOFTWARE/LEARNING WEBSITES

a. Simulation software:-www.keil.com
b. Microcontroller:- www.faqs.org/microcontroller
c. Microcontroller:- https://nptel.ac.in/course.html

d. Memory:- www.slideshare.net/aismahesh/memory-8051
e. Software:-www.edsim51.com
f. Microcontroller project:- www.8051projects.net/download-c4-8051-projects.html

Program Name : Diploma in Electronics Production & Maintenance
Program Code : DEPM
Semester : Fourth
Course Title : Power Electronics
Course Code : 21D44

1. RATIONALE

The objective of this subject is to impart fundamental knowledge and skills regarding basic EE, which diploma holders will encounter in their business life. Electronic control circuits play major role in industries. During this era of automation in industry and manufacturing sector, the mechanical controls are largely replaced by power electronic devices. During this context this course aims at acquainting the pass outs with the essential principles and applications of basic power electronics devices, in order that they will maintain the control circuits utilized in the sector. Hence this course has been designed to realize this aim.

2. COMPETENCY

The aim of this course is to assist the scholars to achieve the subsequent industry identified competency through various teaching learning experiences:

- Maintain power electronic devices in electronic circuits.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills related to this course are to be taught and implemented, in order that the scholar demonstrates the subsequent industry oriented COs related to the above mentioned competency:

a. Understand AC Circuit Theory.
b. Identify power electronic devices in circuits.
c. Maintain triggering and commutation circuits.
d. Use phase controlled rectifiers in different applications.
e. Use choppers and inverters in different applications.
f. Maintain control circuits consisting of power electronic devices.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30	12	100	40	25	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs, Legends: L-Lecture; T— Tutorial/Teacher Guided Theory Practice; P -. Practical; C — Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Measure holding current (1|-|) and latching current (l\J of a given SCR from its V-I characteristic curve.	I	02
2	Test the performance of given IGBT.	I	02
3	Determine break over voltage of given DIAC from its V-I curve.	II	02
4	Test the effect of variation of resistor, capacitor in R and RC triggering circuits of firing angle of SCR.	II	02
5	Test the effects of variation of R on firing angle in synchronized UJT triggering circuit.	II	02
6	Test the performance of Class C-Complimentary type commutation circuit.	III	02
7	Test the performance of half wave controlled rectifier with R, RL load and measure load voltage.	III	02
8	Determine firing angle and output voltage of 3- phase half wave controlled rectifier using Delta-star transformer.	IV	02
9	Test the performance of full wave controlled rectifier with R, RL load and measure load voltage.	IV	02
10	Find output voltage of step-up chopper for different values of duty cycles.	IV	02
11	Test parallel inverter to the measure frequency and output voltages.	IV	02
1 2	Measure output voltages of step-down chopper for different values of duty cycles. Part I.	IV	02
13	Measure output voltages of step-down chopper for different values of duty cycles. Part II.	IV	02
14	Build/test SMPS for mobile phone charging. Part I.	IV	02
15	Build/test SMPS for mobile phone charging. Part II.	V	02
16	Build Light dimmer circuit using TRIAC test the effect of resistance variation on intensity of lamp.	V	02
Total			**32**

Note: -

I. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as `' are compulsory, so that the student reaches the 'Precision Level' of Dave 's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

II. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

Sr. No.	Performance Indicator	Weightage in %
1	Preparation of experimental set up	20

2	Setting and operation	20
3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
TOTAL		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.

The ADOs are not specific to any one PrO, but are embedded in many PrOs, Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in lst year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED –

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

Sr. No	Equipment Name with Broad Specifications	Exp. S. No.
	Power scope: dual channel, dual trace,5Mhz,max voltage 1000 V_{p-p}	4,6,8,9, 11-16
	TONG Tester for ac line current measurement up to 100A	7
	CRO:20 MHz with color display , dual channel, ac voltage 750v max	6-8
	Digital Tachometer- non - contact type up to 2000rpm	Micro project
	LCR Q meter Accurate 0.01% - up to 5 MHz	3,5,1
	Multiple output DC regulated power supply: 0-30V,0-100V,0-300V up to 2A	1,2,10
	Function generator: DC to 10 MHz , max output 0-30Vp-p, sine, triangle, square wave function within build counter.	10
	Single phase DIMMERSTAT :0-300Vac,5A	6-8
	Digital meter for DC voltage measurement up to 700V, DC current measurement up to 1 OA	1,2

0	Desktop PC, 32GFIz with multimedia features, LED monitor	Micro project

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-I Thyristor Family Devices	1a. Explain with sketches the working of the given type of thyristor device. 1b. Interpret V-I characteristics of the given power electronic device. 1c. Calculate latching current (IL) and holding current (In) for the given type of SCR. 1d. Select relevant triggering device for the given circuit with justification. 1.e Identify various power electronic devices along with their specifications. If. Describe with sketches the procedure to troubleshoot the simple given type of thyristor circuit.	1.1 SCR: Construction, operating Principle with Two transistor analogy, V-I characteristics, latching current (IL) and holding current (Ih), applications of SCR. 1.2 Thyristor family devices: LASCR, SCS, GTO and TR1AC, power MOSFET, IGBT : Construction, operating principle, V-l characteristics applications 1.3 Triggering devices- SUS, SBS and DIAC: Construction, operating Principle, V-I characteristics and applications
Unit- II Turn ON and Turn OFF methods of SCR	2a. Describe the turn ON mechanism of the given SCR circuit. 2b. Explain with sketches the effect of the given firing angles on load voltages. 2c. Explain with sketches the methods of triggering for the given SCR. 2d. Explain with sketches the turn OFF method of the given SCR. 2e. Explain with sketches the working of protection circuits for the given SCR against over voltage, over current. 2f. Describe with sketches the procedure to troubleshoot the simple given type of thyristor turn-on/off circuit.	2.1 Concept of turn ON mechanism of SCR: High voltage thermal triggering, illumination triggering, dv/dt triggering, gate triggering of SCR. 2.2 Gate trigger circuits : resistance triggering circuit, resistance, capacitance triggering circuit 2.3 SCR triggering Method: UJT/ PUT-relaxation oscillator circuit , synchronized UJT triggering circuit, pulse transformer and optocoupler (MCT2E) 2.4 Turn OFF methods : Class A-series resonant commutation circuit, class B-Shunt resonant commutation circuit, class C-Complimentary Symmetry commutation circuit 2.5 Protection circuits of SCR: over voltage, over current, snubber circuit and crowbar.

Unit- III Phase controlled Rectifiers	3a. Explain with sketches the effect of change in firing angle on output current of the given rectifier considering concept of phase control. 3b. Interpret the output waveforms of the given phase controlled rectifier for given load condition. 3c. Calculate load voltage and load current of the given controlled rectifier. 3d. Explain effect of the given load on the output of the given controlled rectifier. 3e. Describe with sketches the procedure to troubleshoot the simple given type of phase controlled rectifier.	3.1 Phase control parameters: Firing angle (a) and conduction angle (0). 3.2 Single phase half wave controlled rectifier: circuit diagram, working and waveforms with R and RL load, effect of freewheeling diode with RL load. 3.3 Single phase centre tapped full wave controlled rectifier: circuit diagram, working and waveforms with R and RL load, effect of freewheeling diode with RL load. 3.4 Basic three phase half wave controlled rectifier.
Unit IV Choppers and Inverters	4a. Explain the working of the given Choppers with sketches and formulae. 4b. Explain with sketches the working of the given type of inverter circuit. 4c. Select the chopper and inverter for the given application. 4d. Describe with sketches the procedure to troubleshoot the simple given type of Chopper/Inverter.	4.1 Convertors and its types 4.2 Block diagram and working of step up and step down choppers using power MOSFET. 4.3 Inverters: circuit diagram, working of series inverter, parallel inverter.
Unit-V Consumer Electronic Appliances	5a. Describe the use of power electronic device in the given industrial circuit. 5b. Identify industrial control circuit in the given PCB. 5c. Describe the performance of the given Industrial control circuit. 5d. Explain with sketches the working of the given type of UPS. 5e. Describe with sketches the procedure to troubleshoot the given power electronic application such as the UPS/SMPS and others.	5.1 Light dimmer circuit using DIAC-TRIAC. 5.2 Battery charger using SCR 5.3 Emergency lighting system 5.4 Temperature controller using SCR. 5.5 Block diagram and concept of UPS (on line and offline) 5.6 Block diagram and concept of SMPS.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level ' and above of Bloom's 'Cognitive Domain Taxonomy.

8. **SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN**

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Thyristor Family Devices	12	4	6	**8**	18
II	Turn ON and Turn OFF	10	4	4	6	14
III	Phase controlled Rectifiers	10	2	4	8	14
IV	Choppers and Inverters	10	2	4	8	14
V	Industrial Applications of power electronic devices	06	2	2	6	10
Total		**48**	**14**	**20**	**36**	**70**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Library survey regarding different data sheets and manuals.
b. To collect the literature related to specification of available power devices in the market.
c. Refer technical magazine to collect information of current devices used in power electronics industry.
d. Prepare power point presentation for controlled rectifiers,
f. Visit to nearby industry related to power electronics.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b. 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No. 9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
e. Guide student(s) in undertaking micro-projects.
f. Use PPTs to explain the construction and working of various power electronic devices.
g. Use PPTs to explain the construction and working of controlled rectifiers.

h. Guide students to use data manuals.
i. Deliver seminar on related topic.
j. Prepare industrial visit report with reference to specification, uses of power electronics application.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Controlled Rectifier: Build a circuit of the Battery charger for charging a battery of 6V, 4AH.
b. Controlled Rectifier: Build fan speed regulator circuit using DIAC, TRIAC on zero PCB.
c. Phase controlled Rectifiers: Build the circuit for Speed control of 12V DC shunt motor using IGBT on zero PCB.
d. Phase controlled Rectifiers: Build AC power flasher using two SCRs on zero PCB.
e. Industrial Applications of power devices: Build DC time delay relay using PUT on zero PCB.
f. Turn ON and Turn OFF methods of SCR: Build Ramp and pedestal synchronized triggering circuit using UJT and pulse transformer on zero PCB.
g. Industrial Applications of power devices: Build temperature controller using PT-100 thermistor and thyristor on zero PCB.
h. Industrial Applications of power devices: Build Emergency light system. For 6V battery on zero PCB.
i. Choppers and Inverters: Build Step down chopper using MOSFET/IGBT on zero PCB.
j. Industrial Applications of power devices: Build low power SMPS of 0 to k. 12V DC using suitable power electronic device on zero PCB.

12. SUGGESTED LEARNING RESOURCES: -

Sr. No.	Title of Book	Author	Publication
1	Power Electronics	Moorthi, V.R.	Oxford University Press , New Delhi 110001, 2013, ISBN 0-19-567092-2
2	Fundamentals of Power Electronics	Bhattacharya, S. K.	ISTE Learning materials centre,2006 , ISBN 9788125918530

3	Power Electronics Essentials and Applications	Umanand, L	Wiley India Pvt. Ltd, New Delhi, 2011, ISBN :9788126519453
4	Power Electronics Circuits Devices and Applications	Rashid, Muhammad H.	Pearson Education India, New Delhi, 2012,ISBN: 9780133125100
5	SCR Manual Including TR1ACS and other thyristors (6^{lh} Edition)	General Electric(Author)	General Electric Co,2007, ISBN:9780137967636

13. SOFTWARE/LEARNING WEBSITES

a. https://nptel.ac.in/course.html.
b. PSIM software for power electronics.

Program Name : Diploma in Electronics Production and maintenance
Program Code : DEPM
Semester : Fourth
Course Title : Digital communication system
Course Code : 21D45

1. RATIONALE

The students should understand the advantage and limitations of varied analog and digital modulation systems on a comparative a scale and relate to them while studying practical communication systems. Communication technologies have undergone radical changes, especially thanks to convergence of computers and communication. No industry is untouched by the data communication. This course will enable the diploma engineers to use facts, concepts and dealing principles of data communication for the troubleshooting and maintenance of data communication system. This course is meant to develop the talents to diagnose and rectify the errors occur in data communication system. The concepts and principles of data communication also will lay the inspiration to know the varied modern communication systems.

2. COMPETENCY

The aim of this course is to assist the scholar to achieve the subsequent industry identified competency through various teaching learning experiences:

- Maintain basic digital communication systems.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills related to this course are to be taught and implemented, in order that the scholar demonstrates the subsequent industry oriented COs related to the above mentioned competency:

a. Explain the concept and need of modulation and demodulation.
b. Analyze various error detection and correction codes in digital communication systems.
c. Use various pulse code modulation techniques.
d. Maintain systems based on digital modulation techniques.
e. Multiplex and demultiplex digital signals.
f. Maintain spread spectrum based systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	4	8	3	70	28	30	12	100	40	25	10	25	10	50	20	

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment lo facilitate integration of COs and the remaining 20 marks is the average o f 2 tests lo be taken during the semester for the assessment of the cognitive domain UOs required for the attainment o f the COs.

Legends: L-Lecture; T Tutorial/Teacher Guided Theory Practice; P - Practical; C ESE - End Semester Examination; PA - Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

s. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	To construct the circuit for Generation of hamming code for 4 bits data.	I	02*
2	To construct the circuit for one bit error correction using hamming code.	I	02*
3	Generate: (a) Unipolar -NRZ, RZ (b) Bipolar- NRZ (AMI), Manchester for given data.	I	02
4	Observe the effect of average DC value and bit duration for unipolar non return zero(UPNRZ) and polar return zero(PRZ). Detect error by VRC techniques using relevant simulation tool	I	02
5	Detect error by VRC techniques using relevant simulation tool.	I	
6	Detect error by LRC techniques using relevant simulation tool.	I	02*
7	Test the performance of natural and flat top sampling circuit.	1	02*
8	Test the performance of sampling circuit for variation in sampling frequency.	II	02
9	Test the performance of the Pulse Code modulator/ demodulator circuit.	II	02*
10	Test the performance of the delta modulator/ demodulator circuit. .	11	02
11	Test the performance of the adaptive delta modulator/ demodulator circuit..	II	02
12	Test the performance of the differential pulse code modulator (DPCM) modulator/ demodulator circuit..	II	02*
13	Write a program using a relevant simulation tool to observe sampling process for sampling rate less than, equal to and greater than the Nyquist rate.	II	02
14	Test the performance of the Amplitude Shift Keying(ASK) modulator / demodulator circuits.	II	02*
15	Test the performance of the Amplitude Shift Keying(ASK) using relevant simulation software.	III	02
16	Test the performance of the Binary Phase Shift Keying(BPSK) Modulator and Demodulator circuits.	III	02*
17	Test the performance of Frequency Shift Keying(FSK) Modulator and Demodulator circuits.	III	02
18	Test the performance of the Differential Phase shift keying(DPSK) modulator / demodulator circuits.	III	02*
19	Test the performance of Quadrature Phase shift keying(QPSK) modulator and demodulator circuits.	III	02
20	Test the performance of Quadrature Amplitude Modulation (QAM)	III	02

	modulator and demodulator circuits.		
21	Test the performance for 4-input time division multiplexing circuit.	IV	02*
22	Test the performance for 2- input frequency division multiplexing (FDM) circuit.	IV	02*
23	Generate a TDM signal using relevant simulation software.	IV	02
24	Generate a FDM signal using relevant simulation software.	IV	02
25	Generate PN sequence for given maximum length.	IV	02
26	Generate PN sequence for given maximum length using relevant simulation software.	IV	02
27	Generate two channel CDMA-DSSS signal and demodulate it.	IV	02*
28	Generate two channel CDMA-FHSS signal and demodulate it.	V	02
	Total		**56**

Note: -
i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as `' are compulsory, so that the student reaches the 'Precision Level' of Dave 's 'Psychomotor Domain Taxonomy' as generally required by the industry.*
ii The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

Sr. No.	**Performance Indicator**	**Weightage in %**
1	Preparation of experimental set up:	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
TOTAL		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

f) Follow safety practices.
g) Practice good housekeeping.
h) Demonstrate working as a leader/a team member.
i) Maintain tools and equipment.
j) Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs, Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in lst year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED –

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

Sr. No	Equipment Name with Broad Specifications	Exp. S. No.
1	CRO - Dual trace. 50 M1 1/ and above bandwidth, component tester	1 to 28
2	Spectrum analyzer, 9 kHz to 1.5 GHz Frequency range. Typical -135 dBm.	20-28
3	Function Generator: Frequency Range 0.1 Hz to 30MHZ	1 to 28
4	RF generator/wideband oscillator Wide Frequency Range 100 KHz to 150 MHz	20-28
5	Digital Communication Trainer, In-built internal data generator. Type of Modulations and Demodulations: Sampling. Line coding. PCM, DPCM, DM, ADM, ASK, FSK, BPSK.DPSK, QPSK, QAM,TDM,FDM.TDMA,FDMA,CDMA.FHSS.DSSS	2 to 28
6	Digital storage oscilloscope, 50MHz and above, dual trace,	20-28

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) in cognitive domain)	Topics and Sub-topics
Unit - I Digital Communication System and Coding Methods	1a. Explain function of the given block of digital communication system. 1b. Describe with sketches the given type of characteristics of communication channels. lc. Determine the channel capacity for the given channel noise level. 1d. Construct a Huffman code for the given 'n' bit data. le. Interpret Shannon Hartley Theorem for the given sampling rate. 1f. Compare the given line codes on the basis of average DC value, bit period, bandwidth. 1g. Apply error detection and correction techniques for the given length of data bits to generate the coded data. 1h. Describe the procedure to troubleshoot the specified digital communication equipment	1.1 Elements of Digital Communication system with its block diagram: source, channel, transmitter, receiver advantages and disadvantages of digital communication 1.2 Communication channel characteristics :bit rate, baud rate, bandwidth, repeater distance, applications 1.3 Concept of Entropy and Information rate, channel capacity : Hartley's law, Shannon Hartley's theorem, Source coding: Huffman coding 1.4 Channel/line coding : Error, causes of error and its effect, error detection and correction using parity, checksum, Vertical redundancy Check (VRC), Longitudinal Redundancy Check (LRC), Cyclic Redundancy Check(CRC), Linear block code, Hamming code

Unit-II Pulse Code Modulation Techniques	2a. Explain sampling and quantization process for the given 'q' levels of quantization. 2b. Calculate sampling frequency for the given frequency of signals. 2c. Interpret the utilization of bandwidth for the given pulse modulation technique. 2d. Compare the performance of the given types of pulse.	2.1 Sampling and quantization process: types of sampling, Nyquist sampling theorem (only statement), Aliasing effect, Quantization process, Quantization error/noise, Compounding. 2.2 Pulse code modulation (PCM), Differential pulse code modulation (DPCM): Transmitter and Receive^ block diagram and its workings advantages and disadvantage Delta Modulation 2.3 Delta Modulation (DM): Block diagram of Transmitter and Receiver, slope overload and Granular noise, Advantages and disadvantages of DM. 2.4 adaptive Delta modulation (ADM): Transmitter and Receiver block diagram, advantages and disadvantages of ADM. 2.5 2.4 pulse width modulation, pulse position modulation
Unit- III Digital Modulation Techniques	3a. Summarize the given types of shift keying techniques. 3b. Explain generation of the given type of shift keying signals. 3c. Utilize the given shift keying techniques on the basis of their analysis. 3d. Interpret the constellation diagram for the given keying signals. 3e. Compare the salient features of the given types of digital modulation techniques for the following: bandwidth requirement, SNR, detection method. 3f. Describe the procedure to troubleshoot the specified digital modulation circuit	3.1 Types of Digital modulation techniques and their advantages, concept of Coherent and Non coherent detection. 3.2 Shift keying Techniques : Amplitude Shift Keying (ASK) Frequency shift keying (FSK), Phase shift keying (PSK), Differential Phase shift keying (DPSK), Quadrature Phase shift keying (QPSK), Constellation diagram , transmitter and receiver block diagram and their working with waveforms. 3.3 M-ary encoding: Need, M-ary FSK and M-ary PSK. 3.4 Quadrature amplitude Modulation (QAM): Need, transmitter and receiver block diagram and their working with waveforms, Constellation diagram.

nit- IV Multiplexing and Multiple Access Techniques	4a. Classify the given multiplexing techniques on the basis of domain of working. 4b. Choose the suitable Multiplexing techniques for multiplexing the given number of signals. 4c.Interpret the given Multiplexing hierarchy. 4d. Contrast the given type of multiplexing techniques and Multiple access techniques. 4e. Describe the procedure to troubleshoot the specified multiplexing circuit	4.1 Need and methods of multiplexing: Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Code Division multiplexing (CDM), definition, block diagram and their comparison. 4.2 E and T- carrier multiplexing hierarchy. 4.3 Access techniques: Need and methods-Time Division Multiple Access (TDMA), Frequency Division multiple Access (FDMA). Code Division Multiple access (CDMA).
Unit- V Spread Spectrum Modulation	5a. Interpret the aspects of spread spectrum (SS) Modulation for the given application. 5b. Develop PN Sequence for the Given length of data bits. 5c. Interpret the given spread spectrum Modulation technique. 5d. Compare the performance of the fast and slow frequency hopping on the basis of given parameters.	5.1 Introduction to spread spectrum (SS) Modulation: advantages over fixed frequency, applications of SS modulation, block diagram Spectrum modulation system. 5.2 Pseudo Noise (PN) sequence: definition, generation and maximum length sequence 5.3 Types of SS Modulation: Direct sequence spread spectrum signal (DSSS)and Frequency hopped spread spectrum (FHSS)

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level ' and above of Bloom 's 'Cognitive Domain Taxonomy

8. **SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN**

Unit No.	**Unit Title**	**Teaching Hours**	**Distribution of Theory Marks**			
			R Level	**U Level**	**A Level**	**Total Marks**
I	Digital Communication System and Coding Methods	16	06	08	04	18
II	Pulse Code Modulation	16	04	08	04	16
III	Digital Modulation Techniques	16	04	04	08	16
IV	Multiplexing and Multiple Access Techniques	10	04	04	04	12
V	Spread Spectrum Modulation	06	02	02	04	08
Total		**64**	**14**	**24**	**32**	**70**

Legends: R=Remember, U=Understand, A—Apply and above (Bloom's Revised taxonomy) Note: This specification table provides general guidelines to assist student for their learning and to leachers to teach and assess students with respect to attainment of UOs, The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Follow the safety precautions.
c. Use various meters to test electric/electronic equipment and component.
d. Library /Internet survey of electrical circuits and network.
e. Prepare power point presentation or animation for understanding different circuits behavior.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online course (MOOCs) may be used to teach various topics/sub topics.
b) in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c) About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
d) With respect to item No. 9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
e) Guide student(s) in undertaking micro-projects.
f) Use PPTs to explain the construction and working of rectifier.
g) Use PPTs to explain the construction and working of wave shaping circuits.
h) Guide students for using data manuals.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Build a parity generator/checker circuit using gates/IC. Create an error in one bit and check for parity at the o/p.
b. Build the checksum generator using adder and invertor Gate. Create one bit error and check for the data at the o/p.
c. Build a transistorized chopper circuit to check the natural sampled signal.
d. Build the circuit using sample and hold amplifier to check the flat top sampled signal.
e. Generate an ASK signal generator for two different bit patterns.
f. Develop a circuit to generate FSK.
g. Build a circuit to transmit 2 data signals simultaneously using the same medium.
h. Develop a PN Sequence generator and test for various input sequence

12. SUGGESTED LEARNING RESOURCES: -

Sr. No.	Title of Book	Author	Publication
1	Electronic Communication system	Tomasi, Wayne	Pearson Education, Delhi, 2009, ISBN: 9788131719534
2	Digital Communication	Rao. Ramakrishna P.	McGraw HiIl, Delhi, 2011, ISBN 9780070707764
3	Data Communication and Networking	Forouzan, Behrouz	McGraw Hill, Delhi, 2013, ISBN: 9781259064753
4	Digital Communication	Sklar, Bernald	Pearson Education India, Delhi, Second Edition, 2014, ISBN: 9781292026060

13. SOFTWARE/LEARNING WEBSITES

a. Information theory :-https://www.youtube.com/watch?v=nvmo9voRiSs
b. Digital Modulation technique:-https://www.youtube.com/watch?v=GLnGVB92K78
c. Multiple access:-https://www.youtube.com/watch?v=AKXFwwcww_E
d. DigitalCommunication:-https://www.slideshare.net/lineking/digital-communication-system?qid=2ad04eff>5203 -4d01 -ad26-65e2c9224c8e&v=&b=&from search=2www.youtube.com /Digital communication circuits
e. Data communication and Networking:- http://datacombasic.blogspot.in/2011/03/e-and-t-carrier.html

Program Name : Diploma in Electronics Production & Maintenance
Program Code : DEPM
Semester : Fourth
Course Title : Maintenance of Electronics Equipment and EDA Tools Practices
Course Code : 21D46

1. RATIONALE

The module has been designed to supply an understanding of the fundamentals of Electrical and Electronic with an introduction to varied electronic active & passive components and test equipments. The participants would be familiar with the Electrical Hazards along side work place safety instructions and precautions that require to be taken while handling the Electrical and equipment and appliances. Equipment's with electronic circuitry are increasingly getting used altogether the industries and maintenance of them is that the essential work for the right functioning of the entire system. This course will enable the scholars to develop skills to take care of the essential electronic circuitry utilized in equipment. Functional verification tool confirms that the functionality of a model of a circuit. This course also will enable them to satisfy the essential prerequisite for the advance maintenance issues which they're going to face within the industries.

2. COMPETENCY

The aim of this course is to assist the scholars to achieve the subsequent industry identified competency through various teaching learning experiences:

- Maintain the electronic Equipment/Appliance/Gadgets using EDA tools.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills related to this course are to be taught and implemented, in order that the scholar demonstrates the subsequent industry oriented COs related to the above mentioned competency:

a. Select maintenance policy for specified Equipment/Appliance/Gadgets.
b. Understand the basic terminology and handling of tools and instruments.
c. Select troubleshooting tools for specified work.
d. Maintain the electronic home appliance/consumer electronic products.
e. Simulate electronic circuits using EDA tools.
f. Troubleshoot electronic circuit using the EDA tools.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
-	-	4	4	-	-	-	-	-	-	-	25	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs, Legends: L-Lecture; T— Tutorial/Teacher Guided Theory Practice; P -. Practical; C — Credit ESE - End Semester Examination; PA - Progressive Assessment.

5. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Prepare the work order for the maintenance of the given equipment.	I	2
2	Prepare Bin card for the maintenance of given equipment.	I	2
3	Install closed circuit television (CCTV)	I,III	2
4	Install online/ offline UPS.	I,III	2
5	Test the performance of the given (fractional horse power) DC Motors.	II	2
6	Test the performance of the given Stepper Motor.	II	2
7	Identify / Test various ICs (Analog and Digital) using 1C tester (Analog and Digital).	II	2
8	Troubleshoot the data projector.	III	2
9	Troubleshoot the circuit breaker (MCB and ELCB).	I,III	2
10	Install DTH receiver (Indoor and Outdoor unit).	III	2
11	Troubleshoot the regulated power supply circuit of the given equipment.	III	2
1 2	Troubleshoot the given mixer /grinder with fractional horse power.	III	2
13	Assemble various parts of computer system and install operating system, application software and antivirus on a computer system.	III	2
14	Troubleshoot the domestic water level controller.	III	2
15	Troubleshoot the electronic weighing machine.	III	2
16	Troubleshoot the emergency light system.	III	2
17	Troubleshoot the photo voltaic solar panel power system.	III	2
18	Create new file using given EDA tool to develop the layout of regulated power supply circuit.	IV	2
19	Measure dc current and dc voltage of the given circuit using Node Analysis through EDA simulation tool.	V	2
20	Simulate/Test half wave rectifier circuit using EDA tool.	V	2
21	Measure ac current and voltage of RL, RC and RLC in ac circuit with EDA tool.	V	2
22	Use EDA tool to draw and simulate schematic circuit of full wave rectifiers.	V	2
23	Use EDA tool to simulate two stage RC coupled/transformer coupled/ dc coupled amplifier.	V	2

24	Use EDA tool to draw and simulate given circuit of inverting /non-inverting amplifier using IC741	V	2
25	Use EDA tool to simulate 3-bit adder to match truth table.	V	2
26	Use EDA tool to simulate 4:1 multiplexer, 1:8 de-multiplexer to match truth table.	V	2
27	Use EDA tool to simulate BCD to seven segment decoder.	V	2
28	Develop the PCB of power supply circuit using (layout in Expt. 19).	V	2
Total			**56**

Note: -

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practical's marked as `' are compulsory, so that the student reaches the 'Precision Level' of Dave 's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

Sr. No.	Performance Indicator	Weightage in %
1	Identify the requirements of practical set up	15
2	Operate equipment skill fully	20
3	Record Observations	20
4	Submit report in time	30
5	Attendance and punctuality	15
TOTAL		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Maintain tools and equipment
c. Demonstrate working as a leader / a team member.
d. Awareness of EDA fools.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs, Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in lst year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED –

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

Sr. No	Equipment Name with Broad Specifications	Exp. S. No.
1	Dual Power supply 0- 30V, 2A	2-20
2	Cathode Ray Oscilloscope, Dual Trace 50MHz and above, l Mega Ohm Input Impedance	2-20
3	Function Generator 0-2 MHz with sine, square and triangular wave output with variable frequency and amplitude	3-5,11-13
4	Digital IC tester: Tests a wide range Digital IC's such as 74 Series, 40/45 Series of CMOS IC's Microcontroller, Memories.	8
5	Analog IC tester: Test the general purpose analog ICs :Op-Amp, Voltage regulator, power amplifier, PLL,VCO	8
6	EDA tools like: eSim/ LTSPICE /TINA/OrCAD/ MultiSim/SPICE/ /Easy EDA /Circuit Logix/ MicroCap /SciLAB	21,8
7	Personal Computer, 4GB RAM. 500GB HDD , higher Processor	21,8
8	D.C. Motor, Stepper Motor	
9	Set up of DTH sample : Dish Antenna ,Universal LNBF, Low Loss RF cable (RG-6), Satellite Receiver with Remote Controller (SATTOP Box), Audio Video Cable	10
10	Television set 21 "LCD and LED	10
11	Set up of CCTV installation sample: 4CH DVR, harddisk500Gb, IR Dome camera, video cable, power supply(12v.l Amp.)	3
12	Projector, screen	
13	MCB,ELCB	9
14	For practical related to simulation use	

7. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs)in cognitive domain)	Topics and Sub-topics

Unit -1 Maintenance Management & troubleshooting	1a. Explain with sketch the steps of the given electronic equipment maintenance. 1b. Explain the maintenance policy for The given equipment. 1c. Choose the service option for the maintenance of the given Equipment with justification. 1d. Describe the software installation procedure for the given equipment. 1e. Describe the procedure to troubleshoot the specified equipment	1.1 Objectives of maintenance management; Service and maintenance laboratory. 1.2 Maintenance policy: Concept of Warranty and guarantee; Equipment service options 1.3 Interpreting the service and operation manuals. 1.4 Troubleshooting process. 1.5 Fault finding tools and instruments. 1.6 Troubleshooting techniques and measures. 1.7 Software Installation procedure and policies.
Unit- II Fundamentals of troubleshooting	2a.Describe with block diagram the wiring diagram of the given equipment. 2b.Describe the procedure to locate the fault in the given equipment. 2c.Identify the relevant tools for troubleshooting of the given equipment. 2d. Choose the relevant measure to troubleshoot the given equipment with justification.	2.1 Block, circuit, wiring/line diagram of specified equipment. 2.2 General troubleshooting procedure. 2.3 Fault finding tools. 2.4 General troubleshooting techniques. 2.5 General troubleshooting measures.
Unit- III Maintenance of Electronic domestic appliances	3a. Describe common steps of maintenance of the given home appliances. 3b. Describe common steps of installation of DTH. 3c. Describe common steps of installation of solar power system. 3d. Explain steps to install surveillance system. 3e. Describe the procedure to troubleshoot the specified electronics home appliances.	3.1 Maintenance of home appliances, battery charger, water level controller, emergency light system, SMPS, public address (PA) system. 3.2 Demonstration of offline/online UPS and DTH. 3.3 Installation of solar power system 3.4 Mobile hardware. 3.5 Surveillance system- CCT).

Unit-IV EDA tool and other simulation software	4a. Write main features of the given EDA tool. 4b. Describe the procedure to use different windows to perform the given operations. 4c. Describe the procedure to Create new file in the given EDA tool software. 4d. Describe the procedure to Make changes in the given file.	4.1 Introduction to any of the EDA tools: [SCILAB, esim, spice, LabVIEW, proteus, Oread, Multisim, TINA, MATLAB or any other]. 4.2 Main Features of EDA tool: open file, create new file, run simulation, virtual instrument. 4.3 Editing windows, functions, controls 4.4 File formats, report generation in the given EDA tool.
Unit -V Circuit analysis using EDA Tools	5a. Describe the procedure to Determine the current flowing through the component of the given circuit using Mesh analysis/Nodal. 5b. Calculate current through and voltage across component of the given RLC circuit to check the same with EDA tool. 5c. Describe the steps to use EDA tool to simulate the given type of rectifier. 5d.Sketch the MUX/DEMUX tree for the given number of input and output lines to simulate using EDA tool. 5e. Describe with sketches the process of making PCB for the given circuit.	5.1 Analog Circuit: DC analysis -Loop/ Mesh and Nodal; AC analysis - RL, RC and RLC circuit, peak value, RMS value and Phase value. Op-Amp based circuits: inverting / non inverting amplifiers. 5.2 Digital Circuit: Boolean expressions, Logic Gates, Combinational circuit- Adder, subtractor, multiplexer, decoder. Sequential circuit- flip-flops 5.3 PCB: layout, etching, drilling, mounting, soldering and testing).

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level ' and above of Bloom's 'Cognitive Domain Taxonomy.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable –

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Discuss case study of any fault detection and rectification problem.
c. Maintain the office electronic equipment.

d. Search internet websites about manufacturer, specifications and cost of the measuring and testing equipment.
e. Arrange visit to nearby service electronic industry and prepare the report.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b. 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About 15-20% of the topics/sub-topics which is relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No. 9, teachers need to ensure to create opportunities and provisions for co-curricular activities.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three.* The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.
A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Preform for Logbook - Each group will prepare preformed of logbook, preventive and corrective maintenance (for Any one equipment in laboratory)
b. Prepare a flow chart for fault diagnosis of equipment/gadget available in the laboratory(CRO, Function generator, power supply etc.)
c. Simulate and build circuit on general purpose PCB of Half adder
d. Prepare annual maintenance record of UPS available in college/housing society
e. Prepare proposal for installation and maintenance of EPABX system
f. Prepare proposal for installation and maintenance solar photovoltaic module
g. Design and simulate simple emergency light system using any EDA tool.

12. SUGGESTED LEARNING RESOURCES: -

Sr. No.	Title of Book	Author	Publication
1	Trouble Shooting Electronic Equipment: Includes Repair and	Khandpure, R.S.	Mcgraw-Hill Publishing, New Delhi, 2014, ISBN-
2	Troubleshooting and Maintenance of Electronics Eq I handbook of Repair and Maintenance Of Domestic Electronics Appliances equipment	Singh, K. Sudeep	Katson Book ,New Delhi, Reprint 2013, ISBN: 978-8188458639
3	I handbook of Repair and Maintenance Of Domestic	Sinha, Sakshi Bhushan	BPB Publications, New Delhi, 2016, ISBN:9788183335027
4	Electronic Instruments and System	Gupta, R.G.	Mcgraw-Hill Publishing New Delhi, 2014,ISBN:9780074636299
5	Network Analysis and Synthesis	Ghosh, S.P.; Chakrabarti, A.K.	McGraw Hill Education, New Delhi, 2014, ISBN: 9780070144781
6	Electronics Devices and Circuit Theory	Boylestad, Robert L.	Pearson Publication, New Delhi, 2015, ISBN: 9788131727003
7	The Complete PC Upgrade & Maintenance Guide	Mark, Minasi	Willey Publication, New Delhi, 2010, ISBN: 9788126506279

13. SOFTWARE/LEARNING WEBSITES

a. Open-source EDA tool for circuit simulation:- www.esim.fossee.in
b. Tutorial for e-sim software :- esim.wikia.com/wiki/Tutorial the basics of e-sim
c. Scilab software:- www.scilab.org/download/latest
d. Tina software official website:- https://www.tina.com
e. LT spice software:-http://www.linear.com/designtools/software/#LTspice
f. Open source hard ware project:- http://www.electronics-lab.com/downloads/circutedesignsimulation/?page=5 /
g. Spectrum soft ware:- www.spectrum-soft.com/
h. Troubleshooting support:- www.fixya.com
i. Tutorial Combinational logic:- www.clcctronics-tutorials.ws > Combinational Logic
j. Security camera:-http://www.wikihow.com/Install-a-Sccurity-Camcra-Systcm-for-a-Flouse
k. Home theater:-http://www.audioholics.com/projector-screen-reviews/how-to-mount-projector-and-screen-in-home-theater