Maharashtra State Board Of Technical Education, Mumbai

Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Electronics & Tele-Communication, Diploma in Electronics, Diploma in Communication Technology, Diploma in Communication Engineering,Diploma in Electronics Engineering

Program Code : EJ/EN/EQ/ET/EX With Effect From Academic Year: 2017 - 18

Duration of Program : 6 SemestersDuration : 16 Weeks

Semester : Third Scheme – I

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory						Practical						
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Digital Techniques	DTE	22320	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
2	Applied Electronics	AEL	22329	4	-	4	8	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
3	Electric Circuits and Networks	ECN	22330	3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
4	ElectronicMeasurements and Instrumentation	EMI	22333	4	-	4	8	3	70	28	30*	00	100	40	50@	20	50	20	100	40	200
5	Principles of Electronic Communication	PEC	22334	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
		Total		**19**	**2**	**14**	**35**	--	**350**	--	**150**	--	**500**	--	**175**	--	**175**	--	**350**	--	**850**

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

Theory and practical periods of 60 minutes each. Total Marks : **850**

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

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5marks each for Physics and Chemistry) 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 marks. Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Computer and Electronics Engineering Program Group**

Program Code : **CO/CM/CW/DE/EJ/ET/EN/EX/EQ/IE/IS/IC/MU**

Semester : **Third**

Course Title : **Digital Techniques**

Course Code : **22320**

1. RATIONALE

In the present scenario most of the electronic equipment like computers, mobiles, music systems, ATM, automation and control circuits and systems are based on digital circuits which the diploma electronic engineering passouts (also called technologists) have to test them. The knowledge of basic logic gates, combinational and sequential logic circuits using discrete gates as well as digital ICs will enable the students to interpret the working of equipment and maintain them. After completion of the course, students will be able to develop digital circuits based applications.

2. COMPETENCY

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

- **Build/ test digital logic circuits consist of digital ICs.**

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 number system and codes for interpreting working of digital system.
b. Use Boolean expressions to realize logic circuits.
c. Build simple combinational circuits.
d. Build simple sequential 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				
				Paper	ESE		PA		Total		ESE		PA		Total	
L	T	P		Hrs.	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	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. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

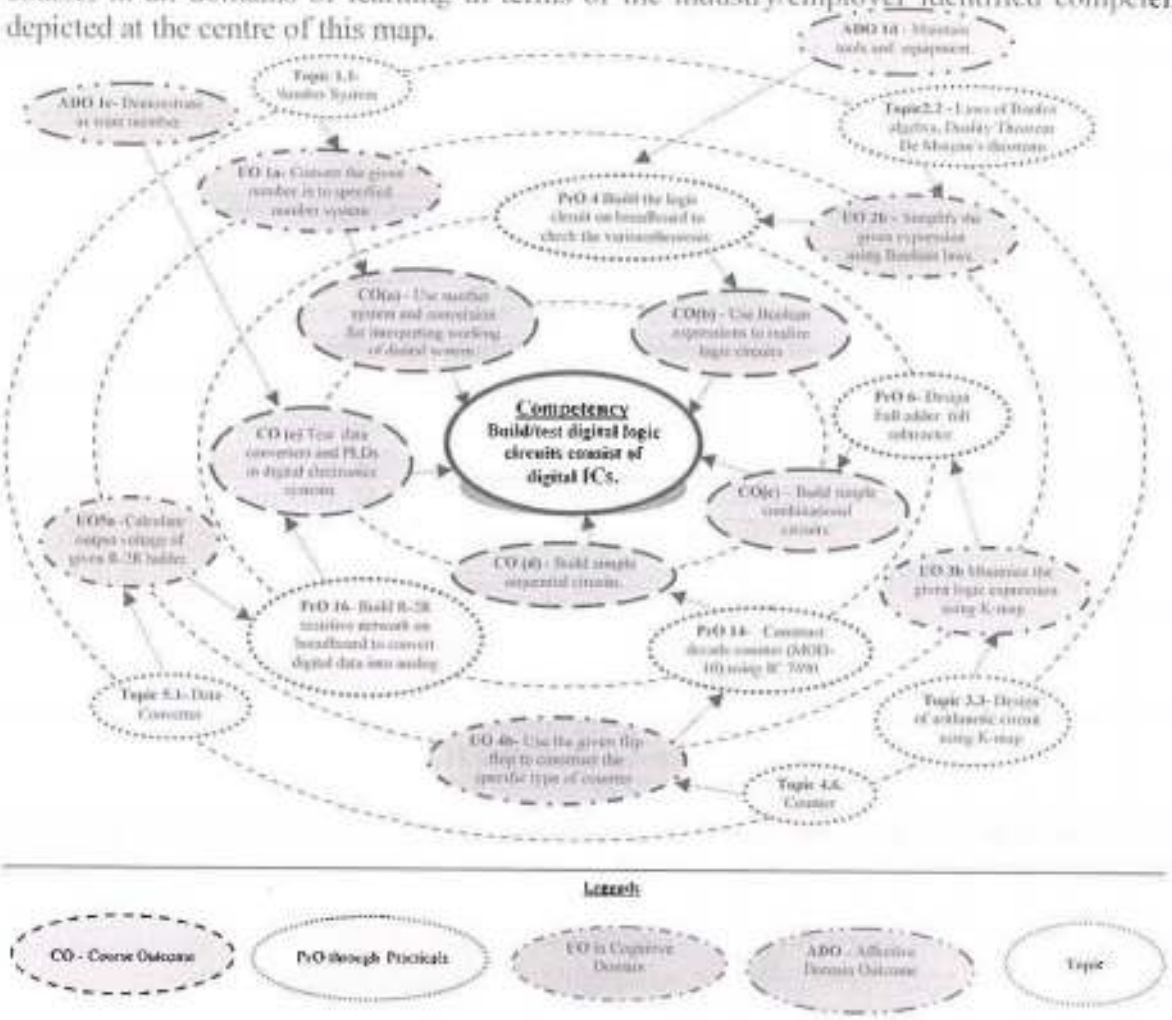

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals 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 gates 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 subtractor using Boolean expressions.	III	02*
6	Design Full adder and full subtractor.	III	02
7	Construct and test BCD to 7 segment decoder using IC 7447/ 7448.	III	02
8	Build / test function of MUX 74151/ [illegible]/any other equivalant.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
9	Build / test function of DEMUX 74155/74154/any other equivalant.	III	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 practicals 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 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 1st year

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

7. 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 ½ digit with R, V, I measurements, diode and BJT testing.	All
2	CRO : Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 MHz X10 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 IC's such as 74 Series, 40/45 Series of CMOS IC's.	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, 7 segment 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 consists of digital ICs for logic gates, flop-flop, 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; 0-2 A 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

8. 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 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.	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. 1.3 Subtraction using 1's complement and 2's complement. 1.4 Codes: BCD, Gray Code, Excess-3, and ASCII code.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1d. Add the given two decimal numbers using BCD code.	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. 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.	2.1 **Logic gates**: Symbol, diode/ transistor switch circuit and logical expression , truth table of basic logic gates (AND, OR, NOT), Universal 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 the component for the given application. 3f. Develop the specified type of code converter.	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 Demultiplexures, MUX tree, IC 74151as MUX; DEMUX tree, DEMUX as decoder, IC 74155 as DEMUX 3.7 **Buffer:** Tristate logic, unidirectional and bidirectional buffer (IC74LS244,74LS245)

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
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 of SR flip flop 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 of IC-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 given type of ADC. 5d. Explain with sketches the working principle of the given types of memories. 5e. Explain with basic block diagram the working principle of the given type of programmable logic device.	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, functionality.

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

9. 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.

10. 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 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 IC's using various testing equipment like digital IC tester, Digital multi-meter 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 IC's 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.

11. 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 should ensure to 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.

12. 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 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

Note: *Use general purpose PCB for making micro projects*

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009 ISBN: 9780070669116
2	Digital Circuits and Design	Salivahanan S.; Arivazhagan S.	Vikas Publishing House, New Delhi, 2013, ISBN: 9789325960411
3	Digital Electronics	Puri, V.K.	McGraw Hill , New Delhi, 2016, ISBN: 97800746331751
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, 2007, ISBN: 9780131989245
6	Digital Electronics, Principles and Integrated Circuits	Maini, Anil K.	Wiley India, Delhi, 2007, ISBN: 9780470032145

S. No.	Title of Book	Author	Publication
7	Digital Fundamentals	Floyd, Thomas	Pearson Education India, Delhi, 2014, ISBN : 9780132737968

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.cse.yorku.ca/~mack/1011/01.NumberSystems.ppt
b. www.people.sju.edu/~ggrevera/arch/slides/binary-arithmetic.ppt
c. www.mathsisfun.com/binary-number-system.html
d. www.codesandtutorials.com/hardware/electronics/digital_codes-types.php
e. www.ee.surrey.ac.uk/Projects/Labview/gatesfunc/
f. www.ee.surrey.ac.uk/Projects/Labview/boolalgebra/
g. www.eng.auburn.edu/~strouce/class/elec2200/elec2200-8.pdf
h. www.maxwell.ict.griffith.edu.au/yg/teaching/dns/dns_module3_p3.pdf
i. www.scs.ryerson.ca/~aabhari/cps213Chapter5.ppt
j. www.eng.wayne.edu/~singhweb/seql.ppt
k. www.cs.sjsu.edu/faculty/lee/Ch2Problems2.ppt
l. www.rogtronics.net/files/datasheets/dac/SedraSmith.pdf
m. www-old.me.gatech.edu/mechatronics_course/ADC_F04.ppt
n. www.allaboutcircuits.com/vol_4/chpt_13/3.html
o. www.youtube.com/watch?v=5Wz5f3n5sjs
p. www.eee.metu.edu.tr/~cb/e447/Chapter%209%20-%20v2.0.pdf
q. www2.cs.siu.edu/~hexmoor/classes/CS315-S09/Chapter9-ROM.ppt
r. www.cms.gcg11.org/attachments/article/95/Memory2.ppt
s. www.cosc.brocku.ca/Offerings/3P92/seminars/Flash.ppt
t. www.webopedia.com/TERM/R/RAM.html
u. www.cs.sjsu.edu/~lee/cs147/Rahman.ppt

Program Name : **Electronics Engineering, Digital Electronics and Instrumentation Engineering Program Group**

Program Code : **DE/EJ/ET/EN/EX/EQ/IE/IS/IC**

Semester : **Third**

Course Title : **Applied Electronics**

Course Code : **22329**

1. RATIONALE

Enhanced use of electronic gadgets has made electronics engineers to deal with the various types of electronic circuits which generate the required analog/digital output. Transistor has remarkably expanded the utility of electronic equipment. Discrete components are widely used in amplifiers and other electronic systems which the engineering diploma holders (also called as technologist) have to use or maintain. The learning of basic operating principles of electronic circuits will help the students to use the basic electronic equipment. This course is developed in such a way that, students will be able to apply the knowledge of basic electronic circuit working to solve broad based electronic engineering application problems.

2. COMPETENCY

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

- **Use discrete electronic devices and voltage regulators.**

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 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 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*	00	100	40	50#	20	50	20	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. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

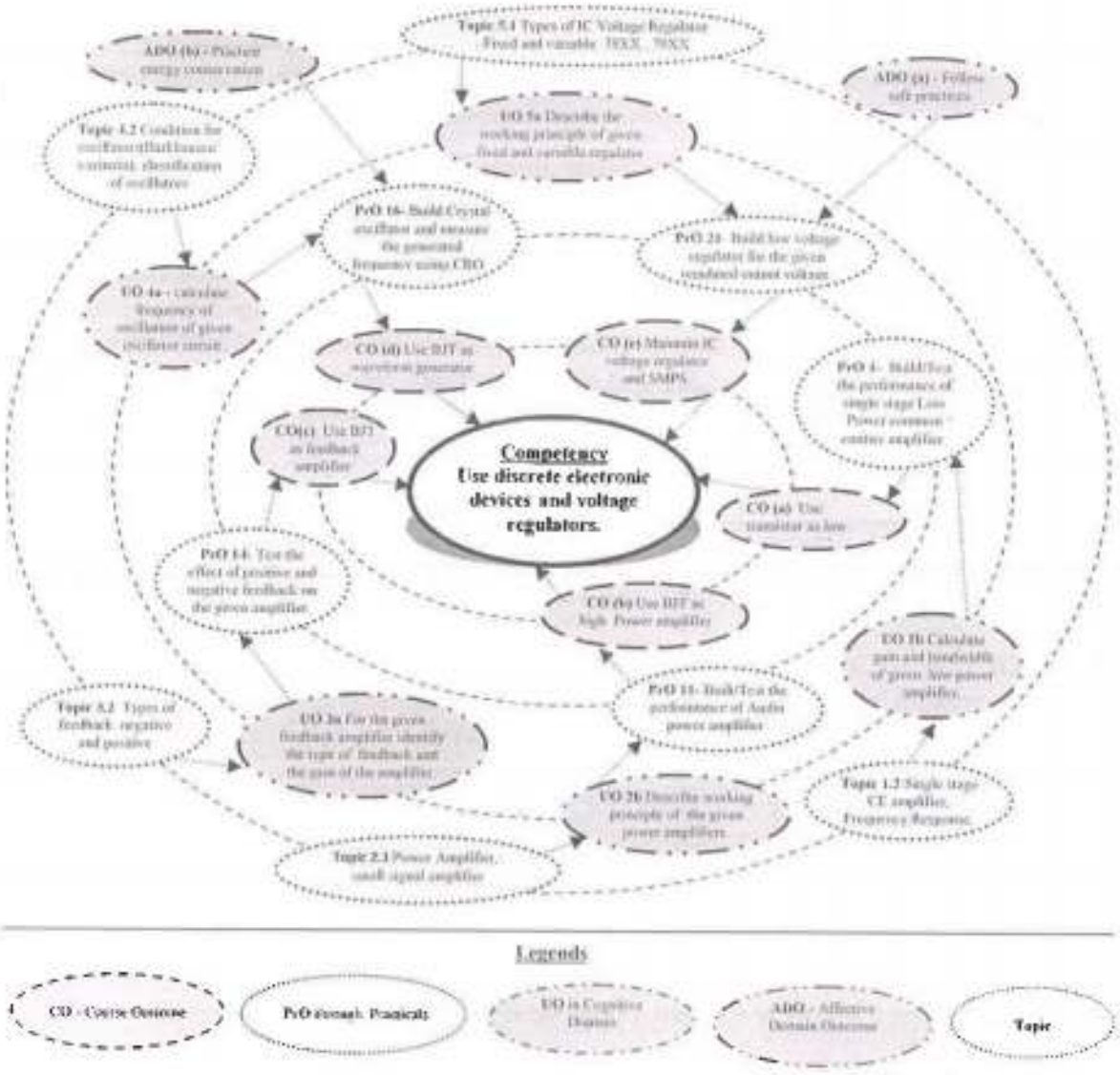

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals 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 Practials (wherever applicable).*

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 out put Wave form of single stage common	I	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	emitter (CE) amplifier using simulation software(like spice, multisim).		
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	2*
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-II)	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 IC78XX 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 IC723 for the given regulated output voltage.(7 V to 37 V)	V	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
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 practical need to be performed, out of which, the practicals 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 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. 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.

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, 1MegaΩ Input Impedance	1-16
4	Digital storage Oscilloscope, Dual Trace 20Mhz and above, 1MegaΩ 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: 3and1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max) , Resistance (0 - 100 MΩ) , 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, C-D, R-Q and Z-Q,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

8. 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 Low Power Amplifiers	1a. Explain with sketches the working principle of the given type of amplifier. 1b. Calculate gain and bandwidth of the given low power amplifier. 1c. Compare performance parameters of the given types of amplifier coupling. 1d. Select relevant tuned amplifier for the given frequency band with justification. 1e. 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	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
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. 3c. Calculate Gain, Bandwidth, Input and Output resistance of the given feedback amplifier. 3d. Compare the performance of given types of negative feedback amplifiers.	3.1 Principle of feedback Amplifier 3.2 Types of feedback: negative and positive feedback, advantages and disadvantages of negative feedback 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. 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'.*

9. 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.*

10. 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

11. 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. 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.

12. 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 4Ω speaker using class A amplifier which is directly coupled and test its performance parameters.
f. Using ClassAB push pull amplifier drive (4Ω/8Ω) 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 voltage 5V using LM IC 723.Drive any 5v operated load.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Applied Electronics	Sedha. R.S.	S.Chand, New Delhi, 2015 ISBN:9788121927833
2	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S.Chand, New Delhi, 2014 ISBN:8121924502
3	Electronic Devices and Circuit Theory	Boylestead, Robert, Neshelsky, Louis	Pearson Education, New Delhi, 2014. ISBN: 9780132622264
4	Fundamental of Electronic Devices and	Bell ,David	Oxford University Press, New Delhi, 2015. ISBN:9780195425239

S. No.	Title of Book	Author	Publication
	Circuits		
5	Electronic Devices and Circuits	Millman, Jacob Halkias, C. Christos Jit, Satyabrata	Mc Graw Hill Education, New Delhi 2015, ISBN:9789339219550
6	Modern Power Electronics	Sen, P.C.	S.Chand, New Delhi, 2015 ISBN:9788121924252

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.eng.uokufa.edu.iq/staff/alikassim/lectures/CH-4.pdf
b. www.electronics-tutorials.ws/amplifier/amp_1.html
c. www.colorado.edu/ physics/phys3330/PDF/Experiment7.pdf
d. www.alldatasheet.com/view.jsp?Searchword=Bc147
e. www.williamson-labs.com
f. www.futurlec.com
g. www.learnerstv.com/video/Free-video-Lecture-870-Engineering.htm
h. www.electronicspost.com/discuss-the-essentials-of-a-transistor-oscillator-explain-the-action-of-tuned-collector-oscillator-colpitts-oscillator-and-hartley-oscillator/
i. www.radio-electronics.com/info/power-management/switching-mode-power-supply/basics-tutorial.php
j. www.circuitstoday.com/ic-723-voltage-regulators
k. www.onsemi.com/pub_link/Collateral/LM317-D.PDF

Program Name : **Electronics Engineering, Digital Electronics and Instrumentation Engineering Program Group**

Program Code : **DE/EJ/ET/EN/EX/EQ/IE/IS/IC**

Semester : **Third**

Course Title : **Electric Circuits and Networks**

Course Code : **22330**

1. RATIONALE

In industry, to build and test electronic/electrical circuits in different situations knowledge of electric circuits and networks is very important. This course is intended to develop the skills to diagnose and rectify the electric network and circuit related problems in the industry. The concept and principles of circuit analysis lays the foundation to understand courses of higher level.

2. COMPETENCY

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

- **Diagonose the electrical and electronic circuits problems.**

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. Check 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			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	2	7	3	70	28	30*	00	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. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

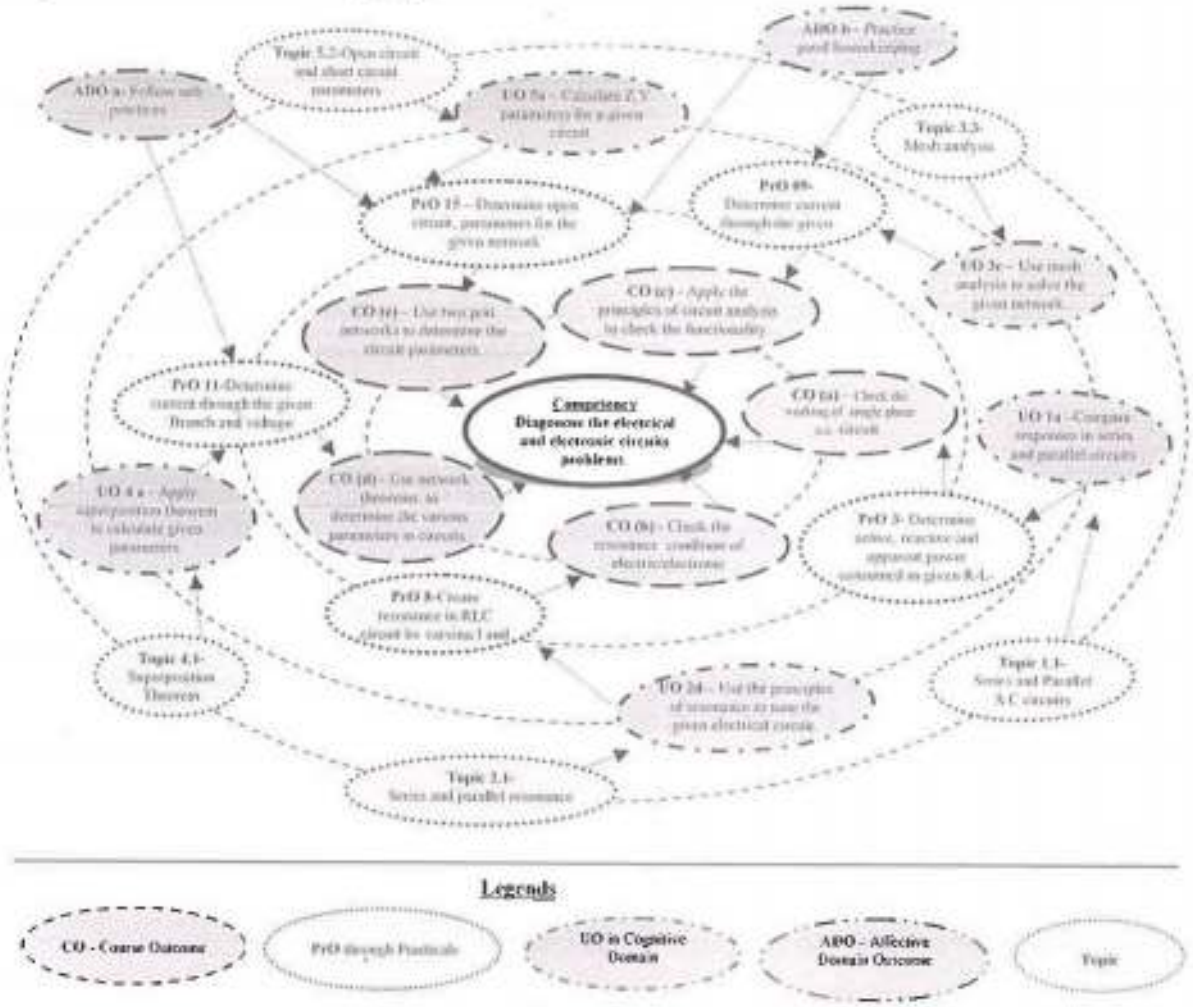

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals 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 digram.	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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
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 a 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 CO's and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals 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 Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. 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, 0-1Amp,0-1.5 Amp,0-2.5Amp,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, 0-5/10Amp.	1 to 17
4	Voltmeter PMMC Type: DC, 0-150/300V, 0-250/500V,0-75/150V.	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. 5/10Amp, 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, 250V.	1 to 5
9	Digital storage oscilloscope 50MHz	6 ,7
10	Trainer kit for all theorems.	9 to 17

8. 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	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 , reactive power, power triangle

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	power and power factor for the specified circuit. 1d. Suggest the power factor improve technique for the given situation with justification. 1e. Calculate admittance,conductance and susceptance for the given circuit. 1f. Determine the equivalent impedance and admittance for the given circuit. 1g. Interpret the working of the given R,L, and C component using initial and final condition.	1.2 AC Series circuit by using complex algebra 1.3 Parallel AC 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 $t = 0-$, $t = 0+$ and $t = \infty$. 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 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	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4d. Calculate load impedance using maximum power transfer theorem for the given circuit. 4e. Use reciprocity theorem to analyse the given circuit.	
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 π 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 π representation of circuits 5.5 Reciprocal and symmetrical two port network(no derivation)

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'.

9. 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.

10. 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 behaviour.

11. 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.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Use Flash/Animations to explain various theorems in circuit analysis
f. Guide student(s) in undertaking micro-projects

12. 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 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 network on bread board for given values of open circuit Z parameter.
g. **Two Port Networks:** Design and prepare two port network on bread board for given values of short circuit Y parameter.

13. 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

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.cesim.com/simulations
b. www.scilab.org/scilab
c. www.ni.com/multisim
d. www.youtube.com /electric circuits
e. www.dreamtechpress.com /ebooks
f. www.nptelvideos.in/electrical engineering/ circuit theory
g. www.learnerstv.com/free-engineering
h. electronicsforu.com/category/electrical-projects

Program Name : **Electronics & Tele-Communication Engineering, Electronics, Electronics & Communication Engineering, Electronics Engg. and Electronics & Communication Technology**

Program Code : **EJ/ET/EN/EX/EQ**

Semester : **Third**

Course Title : **Electronics Measurements and Instrumentation**

Course Code : **22333**

1. RATIONALE

Modern automated instrumentation system is an emerging field, used for data sensing, acquisition, transmission, analysis and control in various practical applications. Analog and digital instruments are mainly used to measure different process control parameters. The physical quantities/parameters are be converted into electrical signal with the help of various types of sensors and transducers and also used to maintain electronic control and automation system. Handling Test and Measuring Instrument is the essential activity of the diploma engineering passouts (also called technologists) when they work in any electronic 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:

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

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*	00	100	40	50@	20	50	20	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. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

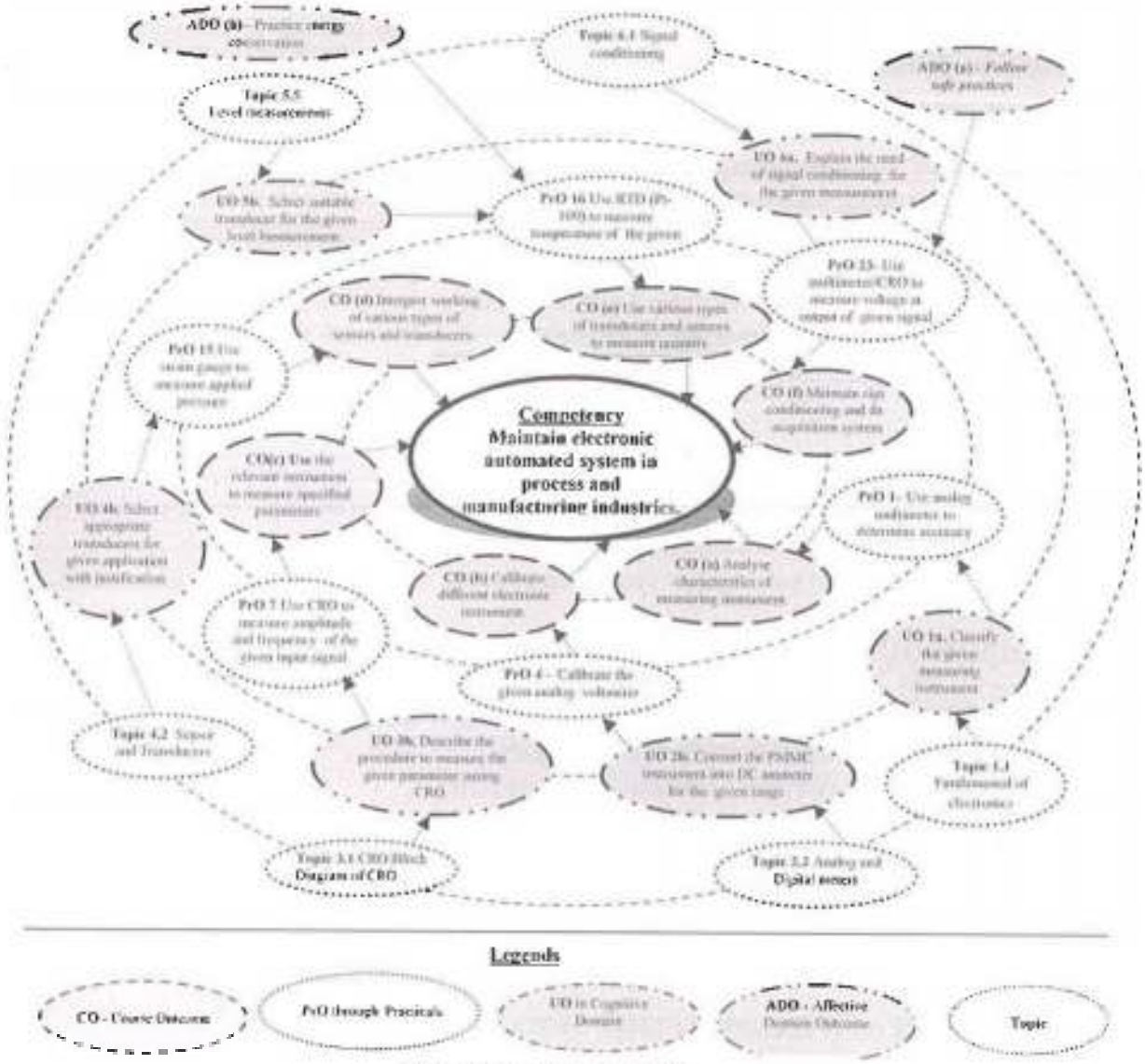

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/EXERCISES

The practicals 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*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
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 varing 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 guage.	VI	02
27	Troubleshoot of venture tube.	VI	02*
28	Troubleshoot of rotameter	VI	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 24 or more practical need to be performed, out of which, the practicals 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 b

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 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 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Analog multi-meter: 0-10A, 0-600V, 0-10MΩ	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), X10 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 ±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, Chromel (+) Alumel (-), 0 to 1260°C	16,17
10	Venturi tube: process temperatures between -20 °F and +350 °F (-30 °C and +175 °C), accuracy of ± 0.50% for standard meters and ± 0.25% for flow calibrated meters. Orifice plate and rotameter:30mm diameter	16,17
11	pH meter: Portable pH meter range from 0 to 14, resolution 0.1/0.01 pH.	22

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
	RS.232C output and supply Data connector cable, digital display with 0.001 pH unit readability	
12	Portable Data Acquisition System Specification: 24-bit ADC/ch, 4 analog voltage inputs, Powered by USB	23,24

8. 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, ACvoltmeter. 2e. Prepare specification of the given analog meter.	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 test and measureing instrument. 3e. Select CRO/ DSO, Spectrum	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

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	analyzer and function generator for specified application with justification. 3f. Prepare specification for the given instrument.	diagram of function generator, application of function generator, 3.4 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. 4e. Select the relevant transducer for the given range of displacement measurement with justification.	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,digital,resistive,capacitive,inductive (LVDT, RVDT), piezoelectric transducer , selection criteria of transducer.
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 application with justification.	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: thermister, RTD (Pt-100), thermocouple: seeback and peltier effects(J,K,R,S,T types),optical pyrometer 5.3 Pressure measurement: Types, Bourdon tube, Bellows, Diaphragm, pressure measurement using Bourdon tube and LVDT 5.4 Flow measurement: types, Variable head flow meter: Venturimeter, orifice plate meter, Variable area flow meter : Rotameter, electromagnetic flow 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 signal conditioning for the given measurement.	6.1 Signal conditioning: need of signal conditioning, Types of signal conditioning: Block

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
and Data acquisition system	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 .	diagram of AC and DC signal conditioning circuits 6.2 Data Acquisition System (DAS): type of DAS, Application of DAS with example

***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'.*

9. 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 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.*

10. 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. Test different components using CRO.
c. Give seminar on any latest Test and measuring Instruments used in the Industry.
d. Library survey regarding different data books of different instruments and manuals.
e. Prepare power point presentation to demonstrate operation of DSO.
f. Undertake a market survey of different electronic instrument.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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. Video programs/YouTube may be used to teach various topics and sub topics.
g. Demonstrate working if measuring instrument to students before they start doing the practice.
h. Encourage students to refer different websites to have deeper understanding of the Measurements.
i. Observe performance of the student continuously and give them feedback about the progress periodically.

12. 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 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 upto 100 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)

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	Dhanpat Rai & Sons,New Delhi ,2005, ISBN: 13-9788177000160
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	Modern Electronic Instrumentation and Measurement Techniques	Helfrick, A.D. Cooper, W.D.	Pearson Eduction India,Ist Edition, New Delhi, 2015 , ISBN-13: 978-9332556065

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.instrumentationcontrolbox.com
b. www.circuitstoday.com
c. www.myklassroom.com/Engineering.../Electronics-&-Instrumentation-Engg.-(EIE)
d. www.en.wikipedia.org/wiki/List_of_electrical_and_electronic_measuring_equipment
e. www.en.wikipedia.org/wiki/Electronic_test_equipment
f. www.en.wikibooks.org/wiki/Electronics/Measuring_Instruments

Program Name : **Electronics & Tele-Communication Engineering, Electronics, Electronics & Communication Engineering, Electronics Engg. and Electronics & Communication Technology**

Program Code : **EJ/ET/EN/EX/EQ**

Semester : **Third**

Course Title : **Principles of Electronics Communication**

Course Code : **22334**

1. RATIONALE

In the 21st century electronic communication plays vital role in every aspect of human life. Diploma Engineers (also called technologists) have to deal with the various electronic communication circuits while maintaining electronics communication systems. The study of basic operating principles and handling of various electronics communication system will help them to troubleshoot and maintain electronics communication systems used for various type of communication. This course is developed in such a way that, students will be able to apply the domain knowledge to solve broad communication engineering application problems in electronic communication engineering field.

2. COMPETENCY

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

- **Maintain basic Electronic Communication Systems.**

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					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	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. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

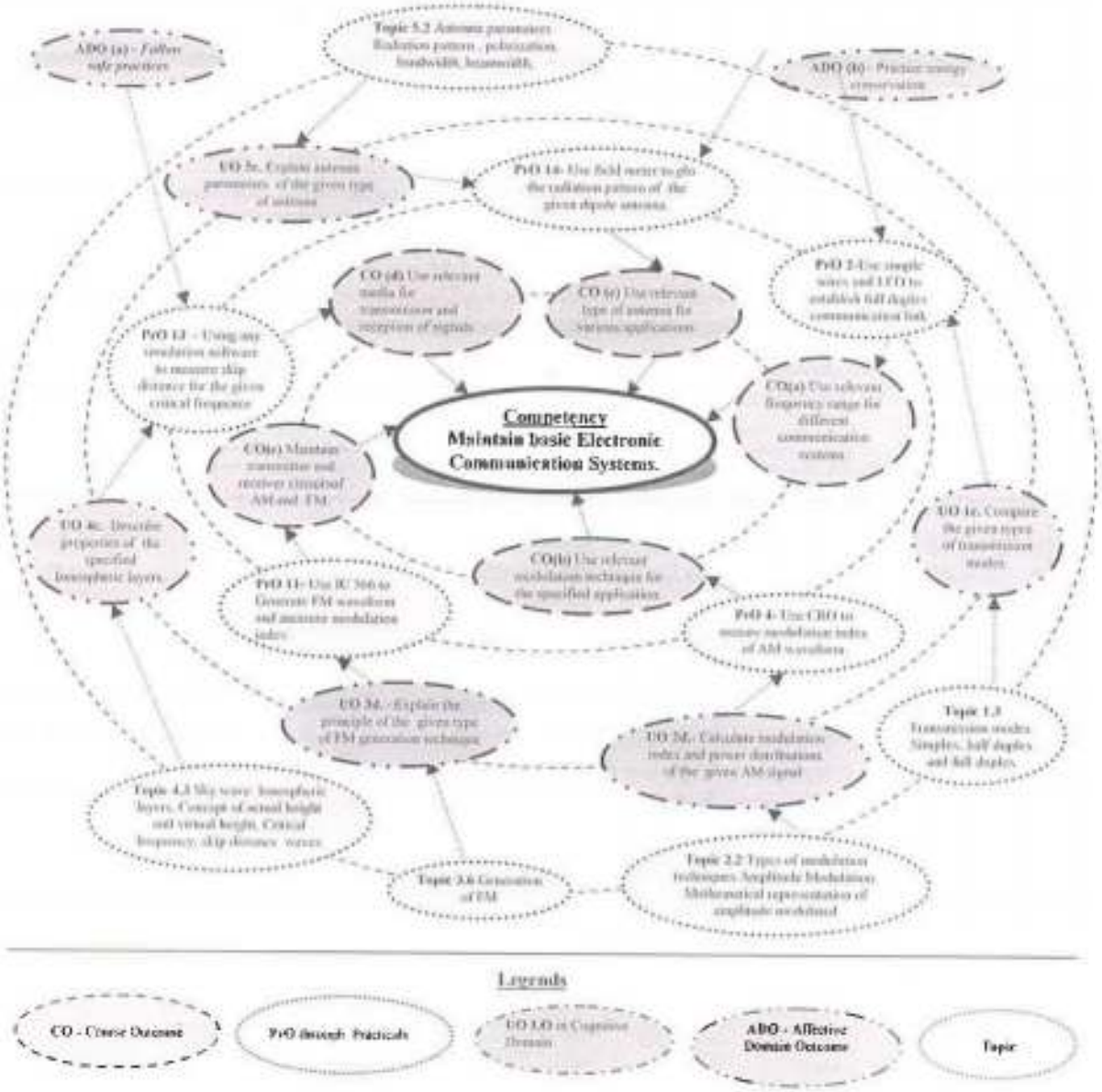

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals 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 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 practicals 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 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. 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, 1MegaΩ Input Impedance	3 to12
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 to12
3	DSO with Bandwidth : 50/100MHz TFT Colour LCD Dual Channel Real Time Sampling: 1GSa/s Equivalent Sampling 25GSa/s Memory 1M pts 10 Waveforms & 10 Setups can be stored	3 to12
4	Regulated power supply: DC Supply Voltages Dual DC : 2 x 0 - 30V;0-2 A 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_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max) . Resistance (0 - 100 MΩ) , Capacitance and Temperature measurement	3 to12
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 , circuit diagram engraved on front panel with transparent rear panel	6,7,10, 11

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
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,omindirection 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

8. 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 – I Basics of Electronic Communication	1a. 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. 1c. Compare features of the given types of transmission modes. 1d. 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	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – II 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.	2.1 Need for modulation 2.2 Types 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(β), 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 given type of radio wave.	4.1 Concept of propagation of radio waves 4.2 Ground Wave propagation 4.3 Sky wave: Ionospheric layers, Concept of actual height and virtual height. Critical frequency, skip

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	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 propogation to be used with justification.	distance , skip zone, concept of fading, maximum usable frequency, multiple hop sky wave propagation 4.4 Space Wave propagation : line of sight, multipath space wave propagation , optical and radio horizon, shadow zones 4.5 Duct propagation (microwave space-wave propogation) 4.6 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'.*

9. 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 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.*

10. 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.

11. 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.

12. 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 [illegible] 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. **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 IFT at 455KHz.

13. SUGGESTED LEARNING RESOURCES

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

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www. turbofuture.com/industrial/Elements-of-Electronic-Communications-System
b. www.st-andrews.ac.uk/~www_pa/Scots_Guide/iandm/part3/page1.html
c. www.antenna-theory.com/basics/main.php
d. www.explainthatstuff.com/antennas.html
e. www.circuitdiagram.org/am-radio-receiver-with-mk484.html
f. www.circuitstoday.com/single-chip-fm-radio-circuit