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 Semesters **Duration : 16 Weeks**

Semester : Fourth **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	Linear Integrated Circuits	LIC	22423	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
2	Consumer Electronics	CEL	22425	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
3	Microcontroller and Applications	MAA	22426	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
4	Basic Power Electronics	BPE	22427	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
5	Digital Communication Systems	DCS	22428	4	-	4	8	3	70	28	30*	00	100	40	50#	20	50	20	100	40	200
6	Maintenance of Electronics Equipment and EDA Tools Practices	MET	22036	-	-	4	4	--	--	--	--	--	--	--	50@	20	50~	20	100	40	100
			Total	**18**	**-**	**16**	**34**	--	**350**	--	**150**	--	**500**	--	**200**	--	**200**	--	**400**	--	**900**

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

Theory and practical periods of 60 minutes each. Total Marks **: 900**

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 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.**
- **In-Plant Training during Summer vacation for minimum Six Weeks at the end of Fourth Semester (Second Year).**

Program Name : **Diploma in Electronics and Telecommunication Engineering**

Program Code : **EJ**

Semester : **Fourth**

Course Title : **Maintenance of Electronics Equipment and EDA Tools Practices**

Course Code : **22036**

1. RATIONALE

Equipments with electronic circuitry are increasingly being used in all the industries and maintenance of them is the essential work for the proper functioning of the complete system. This course will enable the students to develop skills to maintain the basic electronic circuitry used in electronic equipment. This course will also enable them to fulfill the basic prerequisite for the advance maintenance issues which they will face in the industries.

2. COMPETENCY

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

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

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills 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. Select maintenance policy for specified Equipment/Appliance/Gadgets.
b. Select troubleshooting tools for specified work.
c. Maintain the electronic home appliance/consumer electronic products.
d. Simulate electronic circuits using EDA tools.
e. Troubleshoot electronic circuit using the EDA tools.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
-	-	4	4	-	-	-	-	-	-	-	50@	20	50~	20	100	40

*(~[2]): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of UOs holistically, as there is no theory ESE.*

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** -End Semester Examination; **PA** - Progressive Assessment, **'#':** No Theory Examination

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.

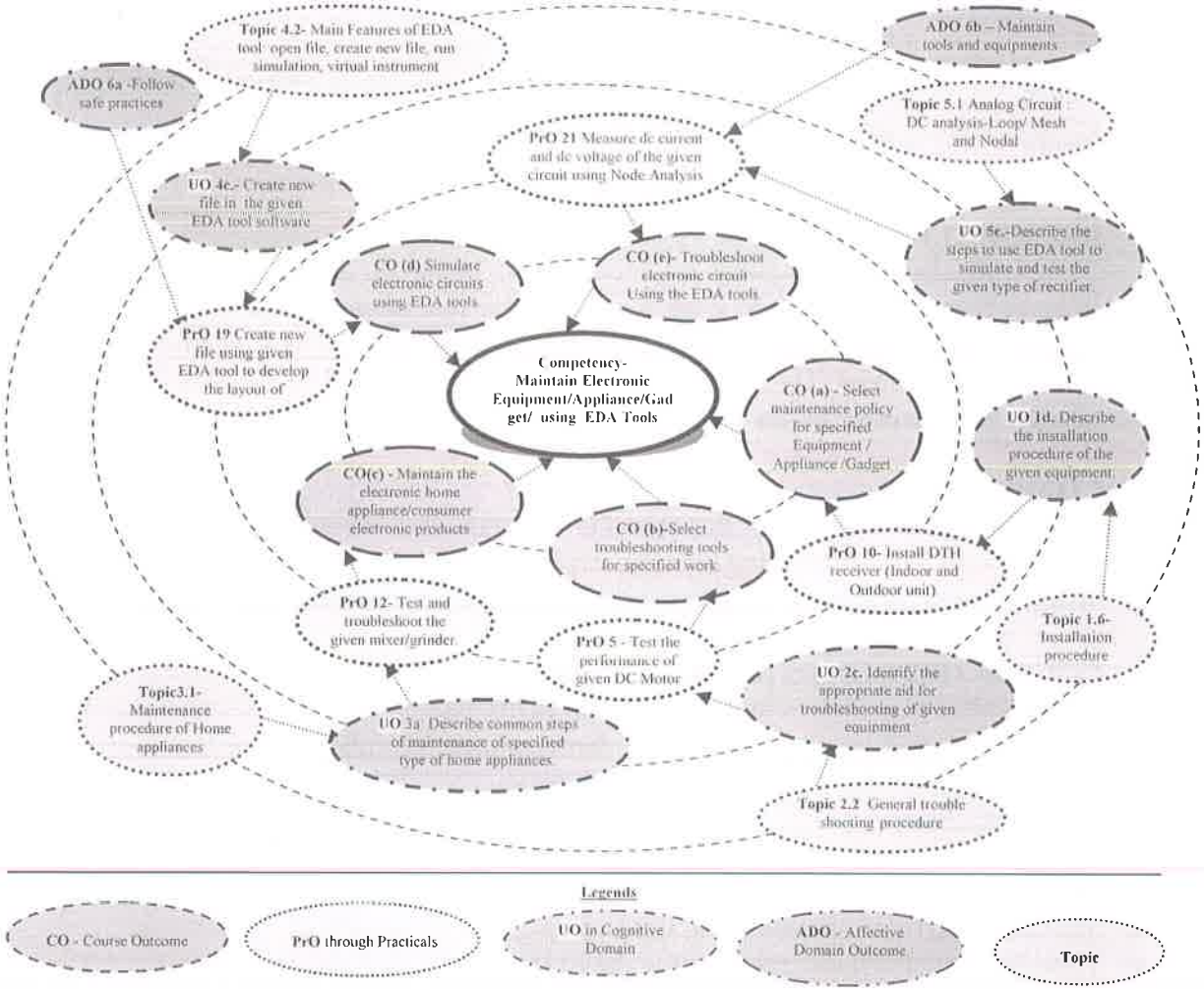

Figure 1 - Course Map

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	Prepare the work order for the maintenance of the given equipment.	I	02*
2	Prepare Bin card for the maintenance of given equipment.	I	02
3	Install closed circuit television(CCTV)	I,III	02
4	Install online/ offline UPS.	I,III	02
5	Test the performance of the given (fractional horse power) DC Motors.	II	02
6	Test the performance of the given Stepper Motor.	II	02
7	Identify / Test various ICs (Analog and Digital) using IC tester (Analog and Digital).	II	02*
8	Troubleshoot the data projector.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
9	Troubleshoot the circuit breaker(MCB and ELCB).	III	02
10	Install DTH receiver (Indoor and Outdoor unit).	I,III	02*
11	Troubleshoot the regulated power supply circuit of the given equipment.	III	02*
12	Troubleshoot the given mixer /grinder with fractional horse power.	III	02
13	Assemble various parts of computer system and install operating system, application software and antivirus on a computer system.	III	02
14	Troubleshoot the domestic water level controller.	III	02
15	Troubleshoot the electronic weighing machine.	III	02
16	Troubleshoot the emergency light system.	III	02
17	Troubleshoot the photo voltaic solar panel power system.	III	02
18	Create new file using given EDA tool to develop the layout of regulated power supply circuit.	IV	02
19	Measure dc current and dc voltage of the given circuit using Node Analysis through EDA simulation tool.	V	02
20	Simulate/Test half wave rectifier circuit using EDA tool.	V	02*
21	Measure ac current and voltage of RL, RC and RLC in ac circuit with EDA tool.	V	02
22	Use EDA tool to draw and simulate schematic circuit of full wave rectifiers.	V	02
23	Use EDA tool to simulate two stage RC coupled/transformer coupled/ dc coupled amplifier.	V	02
24	Use EDA tool to draw and simulate given circuit of inverting /non-inverting amplifier using IC741	V	02
25	Use EDA tool to simulate 3-bit adder to match truth table.	V	02
26	Use EDA tool to simulate 4:1 multiplexer, 1:8 demultiplexer to match truth table.	V	02
27	Use EDA tool to simulate BCD to seven segment decoder.	V	02
28	Develop the PCB of power supply circuit using (layout in Expt. 19).	V	02
	Total		**56**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 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	Identify the requirements of practical set up	15
2	Operate equipment skillfully	20
3	Record Observations	20
4	Submit report in time	30
5	Attendance and punctuality	15

Total	**100**

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

a. Follow safe practices.
b. Maintain tools and equipment
c. Demonstrate working as a leader / a team member.
d. Awareness of EDA Tools.
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 and
- '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	Dual Power supply 0- 30V, 2A	2-20
2	Cathode Ray Oscilloscope, Dual Trace 50MHz and above, 1MegaΩ Input Impedance	2-20
3	Function Generator 0-2 MHz with sine, square and triangular wave output with variable frequency and amplitude	3-5,11-13
4	Digital IC tester: Tests a wide range Digital IC's such as 74 Series, 40/45 Series of CMOS IC's ,Microcontroller, Memories	8
5	Analog IC tester: Test the general purpose analog ICs :Op-Amp, Voltage regulator, power amplifier, PLL,VCO	8
6	EDA tools like: eSim/ LTSPICE /TINA/OrCAD/ MultiSim/SPICE/ /Easy EDA /Circuit Logix/ MicroCap /SciLAB	21-28
7	Personal Computer, 4GB RAM, 500GB HDD , higher Processor	21-28
8	D.C. Motor, Stepper Motor	
9	Set up of DTH sample : Dish Antenna ,Universal LNBF, Low Loss RF cable (RG-6) , Satellite Receiver with Remote Controller (SATTOP Box) , Audio Video Cable	10
10	Television set 21"LCD and LED	10
11	Set up of CCTV installation sample: 4CH DVR, harddisk500Gb, IR Dome camera, video cable, power supply(12v,1Amp.)	03
12	Projector, screen	
13	MCB,ELCB	09
14	For practical related to simulation use	

S. No.	Equipment Name with Broad Specifications	PrO. No.
	scilab/octave/pspice/LTpspice/matlab/multi sim/protues or any other open source software	

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

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

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable -

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. Diagnose fault in the non working home appliance and rectify that.

c. Discuss case study of any fault detection and rectification problem.
d. Maintain the office electronic equipment.
e. Search internet websites about manufacturer, specifications and cost of the measuring and testing equipment.
f. Arrange visit to nearby service electronic industry and prepare the report.

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. 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.

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.

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

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

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Trouble Shooting Electronic Equipment: Includes Repair and Maintenance	Khandpure, R.S.	Mcgraw-Hill Publishing, New Delhi, 2014, ISBN-9780070483576
2	Troubleshooting and Maintenance of Electronics Equipment	Singh, K. Sudeep	Katson Book ,New Delhi, Reprint 2013, ISBN: 978-8188458639
3	Handbook of Repair and Maintenance Of Domestic Electronics Appliances	Sinha, Sakshi Bhushan	BPB Publications, New Delhi, 2016, ISBN:9788183335027
4	Electronic Instruments and System	Gupta, R.G.	Mcgraw-Hill Publishing New Delhi, 2014,ISBN:9780074636299
5	Network Analysis and Synthesis	Ghosh, S.P.; Chakrabarti, A.K.	McGraw Hill Education, New Delhi, 2010, ISBN: 9780070144781
6	Electronics Devices and Circuit Theory	Boylestad, Robert L.	Pearson Publication, New Delhi, 2015, ISBN: 9788131727003
7	The Complete PC Upgrade & Maintenance Guide	Mark, Minasi	Willey Publication, New Delhi, 2010, ISBN: 9788126506279

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. Open source EDA tool for circuit simulation:- www.esim.fossee.in
b. Tutorial for e-sim software :- esim.wikia.com/wiki/Tutorial_the_basics_of_e-sim
c. Scilab software:- www.scilab.org/download/latest
d. Scilab tutorial:-www.scilab.org/resources/documentation/tutorial
e. Tina software official website:- https://www.tina.com
f. Tina software tutorial:-https://www.tina.com/tutorials
g. LT spice software:-http://www.linear.com/designtools/software/#LTspice
h. Open source hard ware project:- http://www.electronics-lab.com/downloads/circutedesignsimulation/?page=5 /
i. Circuitlogix software :-https://www.circuitlogix.com/student_version.ph
j. Spectrum soft ware:- www.spectrum-soft.com/
k. Free e-book:-www.talkingelectronics.com/projects/...1A/BasicElectronics-1A_Page1.html
l. Troubleshooting support:- www.fixya.com
m. Tutorial Combinational logic:- www.electronics-tutorials.ws › Combinational Logic
n. Security camera:-http://www.wikihow.com/Install-a-Security-Camera-System-for-a-House
o. Home theater:-http://www.audioholics.com/projector-screen-reviews/how-to-mount-projector-and-screen-in-home-theater

Program Name : **Electronics Engineering Programme Group**

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

Semester : **Fourth**

Course Title : **Linear Integrated Circuits**

Course Code : **22423**

1. RATIONALE

Operational Amplifier (Op-Amp) is the most versatile Linear Integrated Circuit (IC) used to develop various application in electronic circuits and equipment. Hence this course is intended to develop the skills to build, test, diagnose and rectify the Op-Amp based electronic circuits.This course deals with various aspects of Linear Integrated circuits used in various industrial,consumer and domestic 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:

- **Maintain electronic circuits consisting of Linear Integrated Circuits**.

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 Op-Amp in linear electronic circuits.
b. Use various configurations of Op-Amp for different applications.
c. Troubleshoot various linear applications of Op-Amp for the given specifications.
d. Maintain filters and oscillators used in various electronic circuits.
e. Trooubleshoot specified applications using various linear ICs.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	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.

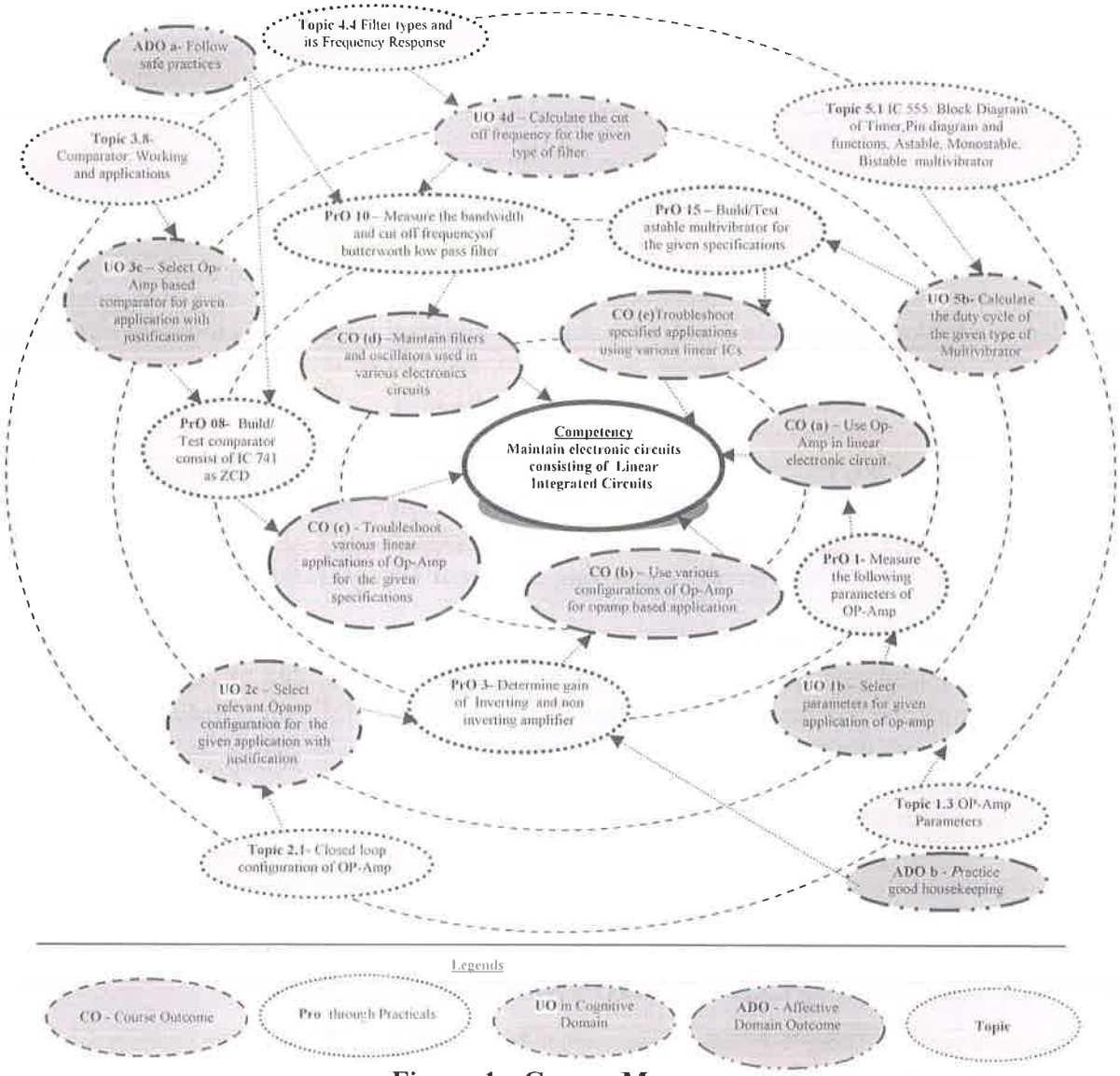

Figure 1 - Course Map

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 relevant instruments to measure the differential input resistance, input offset voltage, output offset voltage and common mode rejection ratio (CMRR) of IC741.	I	02*
2	Measure the Output voltage Swing parameter of Op-Amp IC 741.	I	02
3	Use relevant instruments to determine gain of the Inverting amplifier and Non Inverting amplifier consist of IC741.	II	02*
4	Build/Test adder and subtractor circuit consist of IC 741.	II	02*
5	Build/Test Integrator circuit consist of IC741.	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6	Build/Test differentiator circuit consist of IC741.	II	02
7	Build/Test Voltage to Current converter and Current to Voltage converter circuit consist of IC 741.	III	02
8	Build/Test comparator circuit consist of IC741 as Zero crossing detector and active positive peak detector.	III	02*
9	Build/Test Instrumentation amplifier circuit using IC LM324.	III	02
10	Use relevant instruments to measure the bandwidth and cutoff frequency of the given first order low pass Butterworth filter .	IV	02*
11	Use relevant instruments to measure the bandwidth and cutoff frequency of the given first order high pass Butterworth filter .	IV	02*
12	Use relevant instruments to measure the cutoff frequency of the given notch filter .	IV	02
13	Use relevant instruments to measure the frequency of oscillation of the given RC Phase shift oscillator circuit using IC741.	IV	02
14	Measure the frequency of oscillation of the given wien bridge oscillator circuit using IC741.	IV	02
15	Build/Test astable multivibrator using IC555 for the given specifications.	V	02*
16	Build/Test monostable multivibrator using IC555 for the given specifications.	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 %
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	Variable DC power supply 0- 30V, 2A	All
2	Cathode Ray Oscilloscope Duel Trace 30Mhz, 1MegaΩ Input Impedance	2,3,5,6,8,9,10, 11,12,16,
3	Digital Storage Oscilloscope 25MHz/40MHz/60MHz/100MHz bandwidth,500MS/s to 1GS/s real time sample rate	2,3,5,6,8,9,10, 11,12,13,14,15 , 16
4	Function Generator 0-2 MHz with Sine , square and triangular output with variable frequency and amplitude range.	2,3,5,6,8,9,10, 11,12,13,14,15 ,16
5	Digital Multimeter : 4 1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max)\, Resistance (0 - 100 MΩ)	All
6	Electronic Work Bench : Bread Board 840 1000 contact point, Positive and Negative power rails on opposite side of the board, connecting wires	All

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 Fundamentals of Operational Amplifier(Op-Amp)	1a. Describe with sketches the function of the given block(s) of the Op-Amp. 1b. Select the parameters to be considered for the given applications of the Op-Amp with justification. 1c. Explain with sketches the	1.1 Operational Amplifier, Equivalent Circuit, Circuit symbols and Terminals. 1.2 Op-Amp IC 741 pin diagram and pin function; Op-Amp parameters: Input offset voltage, Input Offset current, Input bias current, Differential input resistence, Input capacitance, Input

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	working of the given type of Op-Amp configuration. 1d. Describe with sketches the procedure to troubleshoot the given Op-Amp circuit.	voltage range, offset voltage adjustment range, Common Mode Rejetion Ratio (CMRR), Supply Voltage Rejection Ratio (SVRR), Slew Rate, Large Signal Voltage Gain, Supply voltage, Supply Current, Output voltage Swing,Gain Bandwidth Product, Output Short Circuit Current 1.3 Transfer Characterstic- Ideal and Practical Voltage Transfer Curve 1.4 Op-Amp Configuration: Open Loop and Closed loop 1.5 Virtual Ground Concept 1.6 Features, pin diagram and pin function of dual Op Amp IC 747,
Unit-II Applications of Operational amplifier	2a. Explain with sketches the working of the given types of modes of Op-Amp operation. 2b. Calculate the output voltage of the given arithmetic circuit consist of Op-Amp . 2c. Select the relevant Op-Amp configuration for the given application with justification. 2d. Calculate the given parameter for the specified Op-Amp configuration.	2.1 Closed Loop configuration, modes of operations: Inverting and Non-Inverting, 2.2 Diffrential amplifier, Unity Gain Amplifier (voltage follower) 2.3 Arithmatic operations: Addition , Scaling, Averaging , Subtraction Integrator, Diffrentiator 2.4 Concept of frequency compensation of Op-Amp and offset nulling
Unit– III Linear Applications of Op-Amp	3a. Explain with sketches the working of an Instrumentation amplifier for the given application. 3b. Choose relevant Op-Amp converter for the given applications with justification. 3c. Select the Op-Amp based comparator for the given application with justification . 3d. Explain with sketches working of Op-Amp for the given application.	3.1 Op-Amp as an Instrumentation amplifier: Working, Derivation of output voltage, IC LM 324- Pin Configuration, specification and application 3.2 Voltage to Current converter with Floating and Grounded load 3.3 Current to Voltage converter 3.4 Sample and Hold Circuit 3.5 Logarithmic and Antilogarithmic amplifier using diodes 3.6 Analog Divider and analog multiplier 3.7 Comparators: IC LM710 a. Zero Crossing Detector b. Schmitt Trigger c. Window Detector d. Phase Detector e. Active Peak Detector f. Peak to Peak Detector

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– IV Filters and Oscillators	4a. Explain working of the given type of filter with sketches. 4b. Explain with sketches procedure to identify the given type of filter based on frequency response. 4c. Calculate cut-off frequency for the given type of filter. 4d. Prepare the specifications of the given type of filter with justification. 4e. Explain with sketches the working principle of the given type of oscillator. 4f. Determine the frequency of oscillation of the given type of oscillator with frequency response. 4g. Describe with sketches the the procedure to troubleshoot the given filter/oscillator circuit.	4.1 Filter and its classification 4.2 Merits and demerits of active filters over passive filters 4.3 Filter characterstic terms:order of filter, cut off frequency,Pass band, Stop band, Centre frequency,Roll off rate, Bandwidth, Q factor 4.4 Filter types and its Frequency Response: Low pass(First Order and second order),High Pass (First Order and second order),Band pass(Wide and Narrow), Band Reject(Wide and Narrow), All Pass Filter 4.5 Ocsillator types using IC 741: Phase shift oscillator,Wein Bridge oscillator, Colpitts oscillator, Hartley oscillator
Unit –V Specialized IC Applications	5a. Explain with sketches the working of IC555 for the given application. 5b. Calculate the duty cycle of the given type of multivibrator. 5c. Explain with sketches the working of the given blocks of PLL. 5d. Calculate lock range and capture range of the given PLL. 5e. Describe with sketches the the procedure to troubleshoot the given circuit with IC.	5.1 IC 555: Block Diagram of Timer,Pin diagram and functions,Astable, Monostable, Bistable multivibrator, Schmitt trigger and Voltage Control Oscillator 5.2 Phase Lock Loop (PLL): Block diagram and its operation, lock range and capture range 5.3 Applications of PLL: PLL as a Multiplier, FM Demodulator. 5.4 IC 565: Pin diagram and function

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

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	Fundamentals of Operational Amplifiers	10	02	02	04	08
II	Applications of Operational Amplifiers	10	02	04	06	12
III	Linear Applications of Op-Amp	18	02	06	12	20

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Filters and Oscillators	16	02	06	10	18
V	Specialized IC Applications	10	02	04	06	12
Total		**64**	**10**	**22**	**38**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist students 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 electronic equipment and component
d. Use datasheets ofvarious Linear ICs.
e. Library / Internet survey of Op-Amp based linear circuits and their applications.
f. Prepare power point presentation or animation for understanding different Op-Amp based circuit behavior.

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. 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.

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. Build Instrumentation Amplifier (IC LM324) for measurement of tempreture using thermocouple/RTD/Thermister.
b. Develop sound sensor using LM324 and microphone.
c. Develop a shadow sensor circuit using IC741.
d. Develop a temperature control dc fan using IC 741.
e. Develop a remote control for switching devices (use IC 555 and TSOP 1738).
f. Develop sequential timer circuit using multiple timers.
g. Develop clap switch using op-amp.
h. Develop water level controller using IC555.
i. Develop a tone generator using using IC 555.
j. Develop PWM LED Dimmer/ Brightness Control using IC555.
k. Build frequency synthesizer using PLL IC565.
l. Develop FSK modulator and demodulator using PLL IC565
m. Simulate using software LT spice/ P psice / Scilab,/Matlab /Octave or any other open source software linear IC applications

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Op-Amps and Linear Integrated Circuits	Gayakwad, Ramakant A.	PHI Learning, New Delhi, 2011, ISBN: 9788120320581
2	Operational Amplifiers and Linear ICs	Bell, David A.	Oxford University Press, New Delhi, India,2011,ISBN: 9780195696134
3	Operation Amplifier with Linear Integrated Circuit	Stanley,Willam D.	Pearson Education India, New Delhi, 2002, ISBN: 9788131708453
4	Design with Operational Amplifier and Analog Integrated Circuit	Franco, Sergio.	McGraw-Hill Education, New Delhi, 2014, ISBN: 9780078028168
5	Linear Integrated Circuits	Sivakumar, Senthil M.	S.Chand Publishing,mNew Delhi, 2014, ISBN: 9788121941136
6	Linear Integrated Circuits	RoyChoudhury, D; Jain, Sail B.	New Age International Publisher, New Delhi, 2003, ISBN: 8122414702
7	Linear Integrated Circuits	Salivahanan S.	McGraw Hill, New Delhi, 2008,ISBN: 978-0-07-064818-0

S. No.	Title of Book	Author	Publication
8	Electronics Lab Manual	Navas, K .A.	PHI Learning, New Delhi, 2014 ISBN: 9788120351424
9	Industrial Electronics and Control	Paul, Biswanath	PHI Learning, New Delhi, 2015, ISBN: 9788120349902

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. Op-Amp:- http://www.jamia-physics.net/lecnotes/lab/opamp.pdf
b. IC555:-http://www.jamia-physics.net/lecnotes/lab/555.pdf
c. IC 555 data sheet:-http://www.electroschematics.com/650/lm555-datasheet/
d. Op-Amplifier basics:-https://www.khanacademy.org/science/electrical-engineering/ee-amplifiers
e. Data sheet555:-www.engineersgarage.com/electronic-components/ne555-timer-ic-datasheet
f. Vide lecture Op-Amp:-http://freevideolectures.com/Course/3062/Electronics-I/37
g. Voltage control Oscilator:- http://www.electronicshub.org/voltage-controlled-oscillators-vco/
h. Op-Amp:-http://www.talkingelectronics.com/projects/OP-AMP/OP-AMP-1.html


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

Program Name : **Electronics Engineering Programme Group**

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

Semester : **Fourth**

Course Title : **Consumer Electronics**

Course Code : **22425**

1. RATIONALE

In developing Nations demand of consumer electronic appliances is increasing day by day. This requires large number of technically trained man power in the relevant industries. Looking towards the present need, in-depth knowledge for maintaining various consumer electronics appliances/equipment is necessary for diploma engineering passout students. This course will introduce the students with working principles, of consumer electronics appliances like audio-video systems, microwave oven, washing machine, air-conditioner, camcorder and others to develop skills to troubleshoot in systematic way. Knowledge so gained would also help in production units of these consumer gadgets or help the students to start their own enterprises.

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 various consumer electronic appliances/equipments**.

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. Troubleshoot different types of microphones and speakers.
b. Maintain audio systems.
c. Analyse the composite video signal used in TV signal transmission.
d. Troubleshoot colour TV receivers.
e. Maintain various consumer electronic appliances.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	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 LOs 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.

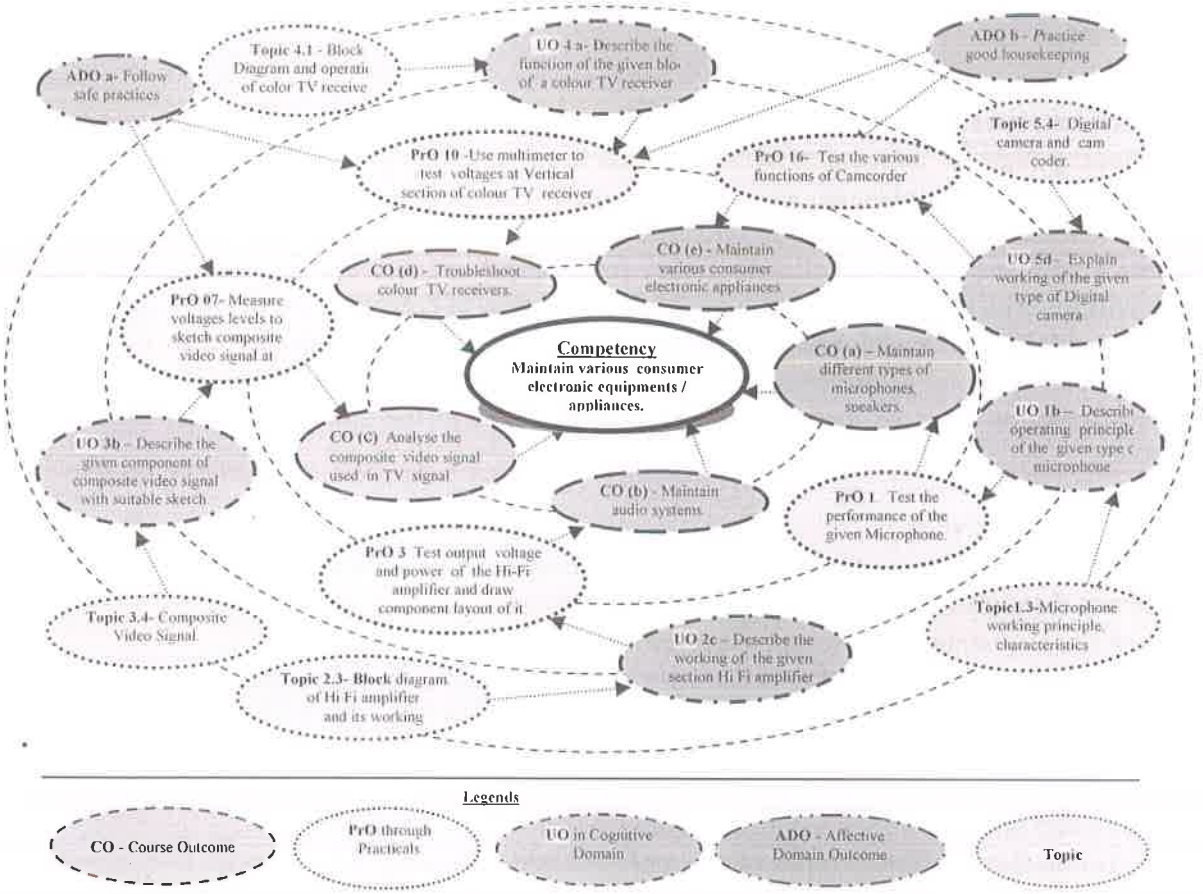

Figure 1 - Course Map

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 performance of the given Microphone.	I	02
2	Test the performance of the given speaker.	I	02*
3	Test output voltage and power of the Hi-Fi amplifier.	II	02
4	Identify any three different faults by voltage analysis method for Hi-Fi Audio amplifier.	II	02*
5	Select exact speed to write a CD for given type of data.	II	02
6	Install/Test the CD for given type of data.	II	02
7	Measure voltage levels to sketch composite video signal at different stages of TV receiver.	III	02*
8	Use multimeter to measure voltage at various test points of colour TV receiver a) chroma section b) Picture Tube	IV	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
9	Use multimeter to test various test points at Horizontal section of colour TV receiver.	IV	02
10	Use multimeter to test voltages at various points of vertical section of the colour TV receiver.	IV	02
11	Suggest the remedy for the Created fault and in the given colour TV trainer kit for the following faults a) No colour b) Red colour only c) Green colour only e) No sound.	IV	02*
12	Suggest the remedy for the following faults in given colour TV a) Fault in HSYNC section b) Fault in VSYNC section.	IV	02
13	Suggest the remedy for the following faults in colour TV a) Fault in SYNC separator b) Fault in video amplifier.	IV	02
14	Test the various sections of LED television receiver.	IV	02
15	Test the various sections of LCD television receiver.	IV	02
16	Test the various functions of Camcoder.	IV	02
17	Test the various features of the given type of printer.	V	02*
	Total		**34**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the 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	Digital Multimeter: 3.5 digit with R , V, I measurements	All
2	Cathode Ray Oscilloscope: Bandwidth : DC-30 MHz dual channel, Rise time: 12 ns approx Accuracy : ± 3 % Input Impedance : 1 Mohm	6,7,8
3	Digital Storage Oscilloscope. Bandwidth : 50/100MHz TFT Colour LCD Dual Channel Real Time Sampling: 1GS	6,7,8
4	Hi Fi amplifier system trainer	3
5	CD player trainer kit	4
6	Color TV receiver trainer kit	5,6,7,8
7	LED television receiver trainer kit	15
8	LCD television receiver trainer kit	16
9	Color Pattern generator	3-16
10	Camcoder.	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 Audio Fundamentals	1a. Differentiate between Mono and Stereo amplifier with respect to the given No. of speaker, No. of amplifiers, quality of sound and application. 1b. Describe the operating principles of the given types of microphones. 1c. Select the microphone for the given application. 1d. Explain with sketches the working principle of the given type of speaker. 1e. Describe the troubleshooting	1.1 Basic characteristics of sound signal: level and loudness, pitch, frequency response, fidelity, sensitivity and selectivity 1.2 Audio Amplifiers: Mono, Stereo 1.3 Microphone: working principle, and characteristics, Types: carbon, condenser, crystal, electrets and tie clip 1.4 Speakers: working principle and characteristics,Types: electrostatic, dynamic, permanent magnet etc., woofers, tweeter and mid range, wireless 1.5 Troubleshooting procedure.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	procedure of the given Microphone/speaker system.	
Unit-II Audio Systems	2a. Describe with sketches the given section of CD player. 2b. Explain with sketches the given mechanism of the give type of CD player with justification. 2c. Explain with sketches the working of the given section of Hi Fi amplifier. 2d. Describe working of the given section of PA system. 2e. Describe the troubleshooting procedure of the given section of the audio system.	2.1 Block diagram and operation of CD player, types of CD player 2.2 Component used for CD mechanism: CD pick-up assembly, gear system, drive motors, CD lens 2.3 Block diagram of Hi Fi amplifier and its working 2.4 Public Address (PA) system: Block diagram and operation, Speaker impedance matching and characteristics 2.5 Home theatre system 2.6 Troubleshooting procedure of audio systems. 2.7 Block diagram and working of MP3
Unit– III Television Fundamentals and Transmitter	3a. Explain with sketches the given type of scanning process. 3b. Describe with sketches the features of the given component of composite video signal. 3c. Explain with sketches the concept of the given type of modulation used in TV signal transmission with justification. 3d. Explain with sketches the given block of colour TV transmitter. 3e. Describe the troubleshooting procedure of the given section of the colour TV transmitter.	3.1 Concept: Aspect ratio, image continuity, interlaces scanning. scanning periods – horizontal and vertical, vertical and horizontal resolution 3.2 Vestigial sideband transmission, bandwidth for Colour signal, characteristics of colour signal, compatibility. 3.3 Colour theory, Grassman's law, additive and subtractive colour mixing Composite Video Signal – Pedestal height, Blanking pulse, colour burst, Horizontal sync pulse details, Vertical sync pulse details, equalizing pulses, 3.4 CCIR-B standards for colour signal transmission and reception, Positive and Negative modulation, merits and demerits of negative modulation 3.5 Block diagram of Colour TV Transmitter. 3.6 Troubleshooting procedure of Colour TV Transmitter
Unit– IV Television Receivers	4a. Describe with sketches the function of the given block of a colour TV receiver. 4b. Describe with sketches the function of the given section of PAL-D decoder. 4c. Compare the salient features of	4.1 Block diagram and Operation of color TV receiver 4.2 Operation of PAL-D decoder 4.3 HDTV: Development of HDTV, NHK MUSE System and NHK Broadcast 4.4 LCD/LED Technology: Principle and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	the given types of TV display. 4d. Explain with sketches the functions of the given block of DTH receiver. 4e. Describe the troubleshooting procedure of the given section of the colour TV receiver.	working of LCD and LED TV 4.5 Direct to Home Receiver (DTH): Concept, receiver block diagram, Indoor and outdoor unit 4.6 Troubleshooting procedure of Colour TV Receiver systems. 4.7 Block diagram and working of OLED
Unit– V Consumer Electronic Appliances	5a. Explain with sketches the working of the given section of the photocopier machine with its specifications. 5b. Prepare specification of a Microwave oven for the specific applications. 5c. Explain with sketches the working of the given section of the given type of washing machine . 5d. Explain with sketches the working of the given type of Digital camera. 5e. Describe the troubleshooting procedure of the given office/ home appliances.	5.1 Photocopier block diagram, working 5.2 Microwave Oven: types, single chip controllers, block diagram, types, and wiring and safety instructions, electrical specifications 5.3 Washing Machine: Block diagram of washing machine, electrical Specifications, types of washing machine: Automatic, semi automatic 5.4 Digital camera and cam coder: pick up devices, picture processing, and picture storage electrical specification. 4.8 Troubleshooting procedure of Colour TV Receiver systems.

***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	Audio Fundamentals	06	02	04	02	08
II	Audio Systems	08	04	04	04	12
III	Television Fundamentals and TV Transmitter	10	06	06	04	16
IV	Television Receivers	12	04	06	04	14
V	Consumer Electronic Appliances	12	04	04	12	20
Total		**48**	**20**	**24**	**26**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist students 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 specifications and applications of different types of Microphone and speaker.
b. Conduct market survey for latest home applications and compare specifications of reputed brands and prepare a report.
c. Make visit to service center of electronic gadgets.
d. Follow the safety precautions.
e. Use various meters to test electric/electronic equipment and component.
f. Library / Internet survey of electrical circuits and network
g. Prepare power point presentation or animation for understanding different circuits behavior.

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.
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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.

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.

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

a. **Battery charger:** Build a Battery charger for mobile phone. Prepare a report.
b. **FM Radio Receiver**: Build FM radio receiver using IC TEA5591.
c. **Installation of DTH**: Install DTH indoor and outdoor unit.
d. **Up Down counter**: Build a circuit for 2digit Up Down counter at gates of a mall/Parking space.Prepare a report.
e. **Timer delay** : Build a Timer delay using IC 89c51
f. **Gas leakage detector:** Develop a circuit for LPG gas leakage detector. Prepare a report.
g. **Smoke detector**: Build a Smoke detector circuit for office/hospitals. Prepare a report.
h. **Light ON OFF control**: Develop a circuit for Light ON OFF control using mobile app and Bluetooth. Prepare a report.
i. **Temperature controller: Temperature** controller using microcontroller. Prepare a report.
j. **PA system**: Develop a PA system for small conference hall.
k. **Bar code reader**: Build a Bar code reader circuit for super market/library.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Consumer Electronics	Bali, S.P.	Pearson Education India, Delhi, 2007; ISBN: 9788131717592
2	Audio video systems principles, maintenance and troubleshooting	Gupta, R.G.	Mc graw Hill, New Delhi, India 2010, ISBN: 9780070699762
3	Audio video systems : principle practices and troubleshooting	Bali, Rajeev ; Bali, S.P.	Khanna Book Publishing Co. (P) Ltd., 2014 Delhi , ISBN:9788187522058
4	Modern Television Practice: Transmission, Reception and Applications	Gulati, R.R.	New Age International, New Delhi Year 2015, ISBN: 978-81-224-3784-3
5	Television and video Engineering	Dhake, A.M	McGraw- Hill, New Delhi, India 2006, ISBN: 0-07-460105-9

14. SUGGESTED SOFTWARE/LEARNING WEBSITE

a. Microphone:-\https://www.coursehero.com/file/18404103/7-Microphonesppt/
b. CD player: www.tclauset.org/cpg132/albums/FTPupLoads/PPT_05/CDs_SperosS.ppt
c. Microwave oven: www.calvin.edu/~pribeiro/courses/engr302/Samples/Microwave.ppt
d. www.sharpthai.co.th/backoffice/img/download.../ES-D159T-SLWH%20ENG.pdf
e. Photocopier machine:www.youtube.com/watch?v=NxUbPE8RsiM
f. Microwave :-www.slideshare.net/fascinating/microwaves-presentation
g. Television: https://www.slideshare.net/PravinShirke07/colour-television
h. Colour TV theory: https://www.slideshare.net/slhallman/color-theory-533704

Program Name : **Electronics Engineering Programme Group**

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

Semester : **Fourth**

Course Title : **Microcontroller and Applications**

Course Code : **22426**

1. RATIONALE

Microcontroller is used in almost all the domestic, industrial, consumer goods and other high end products.Automation is used in every field of engineering and microcontroller is inbuilt element of these systems and devices.Diploma engineers have to deal with various microcontroller based systems and maintain them. This course is intended to develop the skills to maintain and solve the application problems related to microcontrollers.

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 microcontroller based 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. Analyse architecture of microcontrollerICs.
b. Interpret the program for 8051in assembly language for the given operations.
c. Interpret the program by using timer, interrupt and serial ports /parallel ports.
d. Interface the memory and I/O devices to 8051 microcontroller.
e. Maintain microcontrollerused in differentapplication.

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.

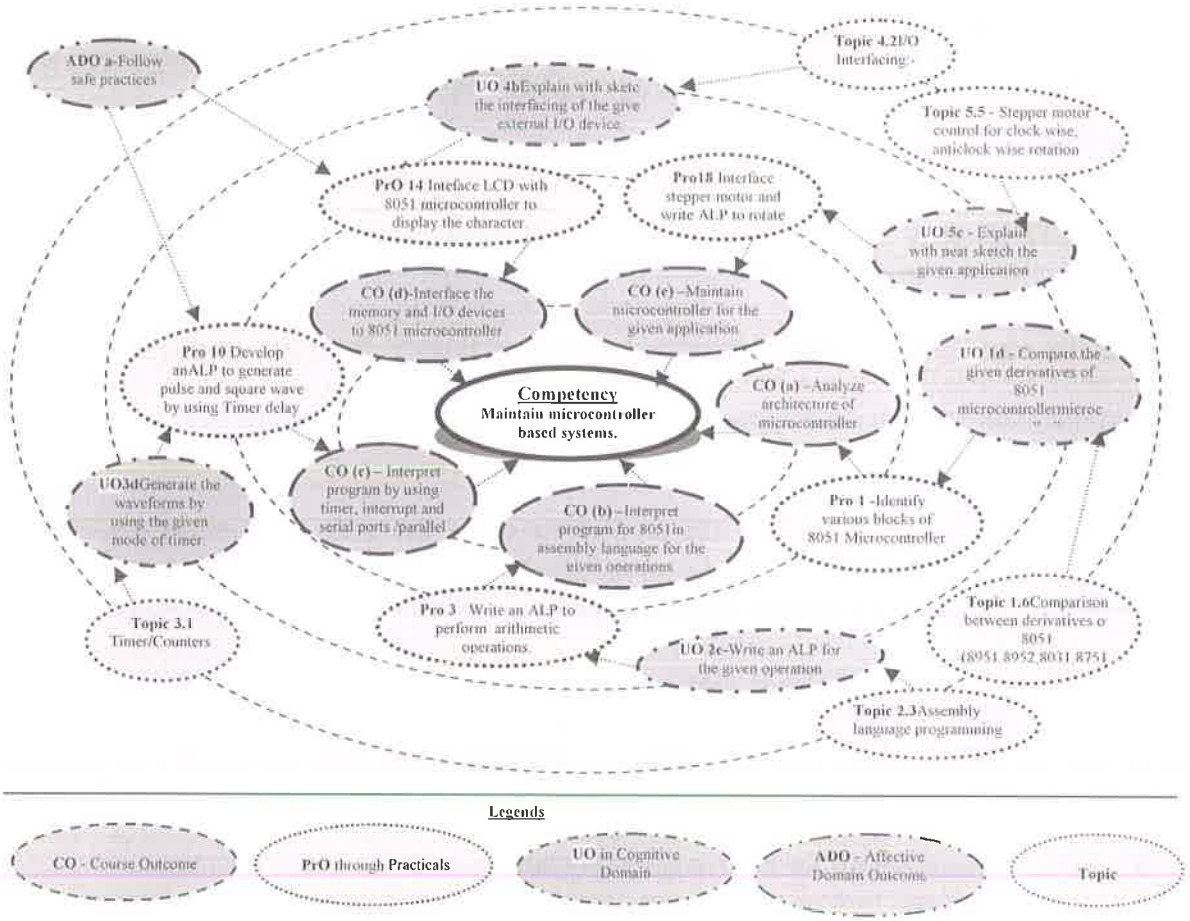

Figure 1 - Course Map

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	Identify various blocks of 8051 microcontroller development board.	I	02*
2	Write sample assembly language program using various addressing modes and assembler directives.	I	02
3	Write an assembly language program (ALP) to perform arithmetic operationsaddition, subtraction, multiplication and division.	II	02
4	Write an ALP to transfer data from source to destination location of internal/external data memory.	II	02*
5	Write an ALP to find smallest/largest number from the given data bytes stored in internal/external data memory locations.	II	02
6	Write an ALP for arranging numbers in ascending /descending order stored in external memory locations.	II	02
7	Write an ALP to generate delay using register.	II	02*
8	Write an ALP to transfer 8 bit data serially on serial port.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
9	InterfaceLED with microcontroller and turn it ON with microcontroller interrupt.	III	02
10	Develop an ALP to generate pulse and square wave by using Timer delay.	III	02*
11	Interface 4 X 4 LED matrix with 8051 to display various pattern.	III	02*
12	Interface 7-segment display to display the decimal number from 0 to 9.	IV	02
13	Interfcerelay with microcontroller and turn it ON and OFF.	IV	02*
14	Interface LCD with 8051 microcontroller to display the character and decimal numbers.	IV	02*
15	Interface the given keyboard with 8051and display the key pressed.	IV	02
16	Interface ADC with 8051 microcontroller and verify input/output .	IV	02*
17	Interface DAC with 8051 microcontroller and observefollowingwaveforms: square wave, triangular wave, sawtooth wave.	IV	02*
18	Interface stepper motor to microcontroller and rotate in clockwise and anti-clockwise direction at the given angles.	V	02*
	Total		**36**

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the 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	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display,PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in power supply or any other equivalent.	All
2	Desktop PC with microcontrollersimulation software.	All
3	Stepper Motor, 50/100 RPM	18
4	CRO- Bandwidth AC 10Hz ~ 20MHz (-3dB). DC ~ 20MHz (-3dB), X10 Probe	17
5	Keyboard 4*4trainer board	15
6	Relay trainer board suitable to interface with 8051 trainer kit	13
7	4 X 4 LED matrix suitable to interface with 8051 trainer kit	
8	7-segment LED Display:- 0.56 in 1-digit, common anode/common cathode	12
9	ADC (0808)trainer board	16
10	DAC (0808)trainer board	17
11	LCD trainer board	14

8. UNDERPINNING THEORY COMPONENTS

The following topicsare to betaught 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 Basics of Microprocessor and 8051 Microcontroller	1a. Compare salient features microprocessor, microcontroller and microcomputer for the given parameters. 1b. Describewith sketches the function of the specified blocks of the thegiven type of microcontroller architecture. 1c. Explain with sketches memory organization of 8051 microcontroller. 1d. Compare the given derivatives	1.1 Microprocessor ,microcomputers, and microcontrollers (basic introduction and comparison) 1.2 Types of buses,addressbus,data bus and control bus 1.3 Harvard and Von-neuman architecture; 8051 microcontroller:Architecture,Pin configuration, stack ,memory organization 1.4 Boolean processor , power saving options - idle and power down

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	of the 8051 microcontroller. 1e. Describe with sketches the procedure to troubleshoot the simple given microcontroller-based circuit.	mode 1.5 Derivatives of 8051 (8951 , 8952 , 8031 ,8751)
Unit-II 8051 Instruction Set and programming	2a. Identify the addressing mode of the given instruction. 2b. Describe the function of the given instruction with suitable examples. 2c. Write an assembly languge program(ALP) for the given operation. 2d. Explain the function of the given software development tools. 2e. Explain the use of the given assembler directives with examples.	2.1 Addressing modes 2.2 Instruction set (Data transfer, Logical, Arithmatic, Branching, Machine control, Stack operation, Boolean) 2.3 Assembly language programming (ALP) 2.4 Software development cycle: editor , assembler , cross-compiler, linker,locator,compiler 2.5 Assembler Directives: ORG , DB , EQU , END,CODE,DATA
Unit III 8051 Timers, Interrupts , Serial and Parallel Communicatio n	3a. Write an ALP to generate a delay for the given crystalfrequencyfor the specified waveform on the given port 3b. Explain with sketch the operation of the given mode for timer and counter. 3c. Explain with sketch the operation of the given mode for serial communication. 3d. Generate the waveforms by using the given mode of timer. 3e. Describe with sketches the procedure to troubleshoot the simple given timer circuit.	3.1 Timer/Counters :SFRs:TMOD,TCON,Timer/Counter - Logic and modes,Simple programs on timer to generate time delay 3.2 Interrupts-SFRs:- IE, IP , Simple programs on interrupts 3.3 Serial communication - SFRs: SCON , SBUF , PCON, Modes of serial communication. Simple programs on serial communication 3.4 I/O port structure and configuration - P0 , P1 , P2 ,P3
Unit–IV 8051 Memory and I/O device Interfacing	4a. Describe with sketch the interfacing of the given external memory. 4b. Explain with sketch the interfacing of the given external I/O device. 4c. Write an assembly languge program to operate the given I/O device. 4d. Describe with sketches the interfacing diagram of the given ADC chip. 4e. Describe with sketches the	4.1 Memory interfacing :-Program and data memory 4.2 I/O Interfacing:-LED, relays, keyboard,LCD,seven segment display,Stepper motor. 4.3 Interfacing DAC - 0808 with 8051 and itssimple programming 4.4 Interfacing ADC - 0808/09 with 8051 and its simple programming

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

***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 FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Microprocessor and 8051 Microcontroller	16	04	06	08	18
II	8051 Instruction Set and programming	12	02	04	06	12
III	8051 Timers,interrupts ,serial and parallel communication	14	04	04	08	16
IV	8051 Memory and I/O device Interfacing	12	02	04	06	12
V	Applications of 8051 Microcontroller	10	02	04	06	12
Total		**64**	**14**	**22**	**34**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist students 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 inlaboratory.
b. Follow the safety precautions.
c. Give seminar on relevant topic.
d. Library/ Internet survey regarding different data books and manuals.
e. Prepare power point presentation on applications of microcontroller.
f. Undertake a market survey of different microcontrollers.

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. 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 thecorse.
h. Observe continuously and monitor the performance of students in Lab.

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. Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
b. Prepare a chart of stepper motor to display its features and steps for its operations using data sheets.

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

Note: Use appropriate software for programming. Build the circuit on PCB.
Faculty may suggests other than above metionedmicroprojects.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	8051 Microcontroller Architecture, Programming and Application	Kenneth J.Ayala	PHI Learning New Delhi,July 2004, ISBN: 978-1401861582
2	Microcontroller Theory and Application	Ajay V.Deshmukh	McGraw Hill, New Delhi, 2011, ISBN- 9780070585959
3	Microcontrollers Principle and Application	AjitPal	PHI Learning,New Delhi, 2014, ISBN: 978-81-203-4392-4
4	The 8051 Microcontroller and Embedded system Using Assembly and C	Muhammad Ali Mazidi, Janice GillispieMazidi,Rolin D.Mckinlay	Pearson /Prentice Hall, , 2nd edition, Delhi,2008, ISBN 978-8177589030
5	Microcontroller Architecture Programming, Interfacing and System Design	Raj Kamal	Pearson Education, Delhi, 2012, ISBN:9788131759905
6	Microprocessors and Microcontrollers	Sunil Mathur, JeebanandaPanda	PHI Learning,NewDelhi, 2016,ISBN :978-81-203-5231-5
7	Microprocessors and Microcontrollers:Architecture programming and System Design	Krishna Kant	PHI Learning New Delhi, 2016,ISBN:978-81-203-4853-0

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. Simulation software:-www.keil.com
b. Microcontroller:- www.faqs.org/microcontroller
c. Microcontroller:- www.nptel.ac.in/courses/Webcourse-contents/IITKANPUR/microcontrollers/micro/ui /Course_home2_5.htm
d. Memory:- www.slideshare.net/aismahesh/memory-8051
e. 8051 microcontroller:- www.intorobotics.com/8051-microcontroller-programming-tutorials- simulators-compilers-and-programmers/
f. Microcontroller instructions:- www.electrofriends.com/articles/electronics/microcontroller-electronics-articles/8051-8951/80518951-microcontroller-instruction-set/
g. Microcontroller:- www.ikalogic.com/part-1-introduction-to-8051-microcontrollers
h. Microcontroller:- www.binaryupdates.com/switch-with-8051-microcontroller/
i. Software:-www.edsim51.com
j. Microcontroller:- www.mikroe.com/chapters/view/64/chapter-1-introduction-to-microcontrollers/
k. Microcontroller project:- www.8051projects.net/download-c4-8051-projects.html


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **Electronics Engineering Programme Group**

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

Semester : **Fourth**

Course Title : **Basic Power Electronics**

Course Code : **22427**

1. RATIONALE

Electronic control circuits play major role in industries. In this era of automation in industry and manufacturing sector, the mechanical controls are largely replaced by power electronic devices. In this context this course aims at acquainting the pass outs with the basic principles and applications of basic power electronics devices, so that they can maintain the control circuits used in the field. Hence this course has been designed to achieve this aim.

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 power electronic devices in electronic circuits.**

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

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	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.

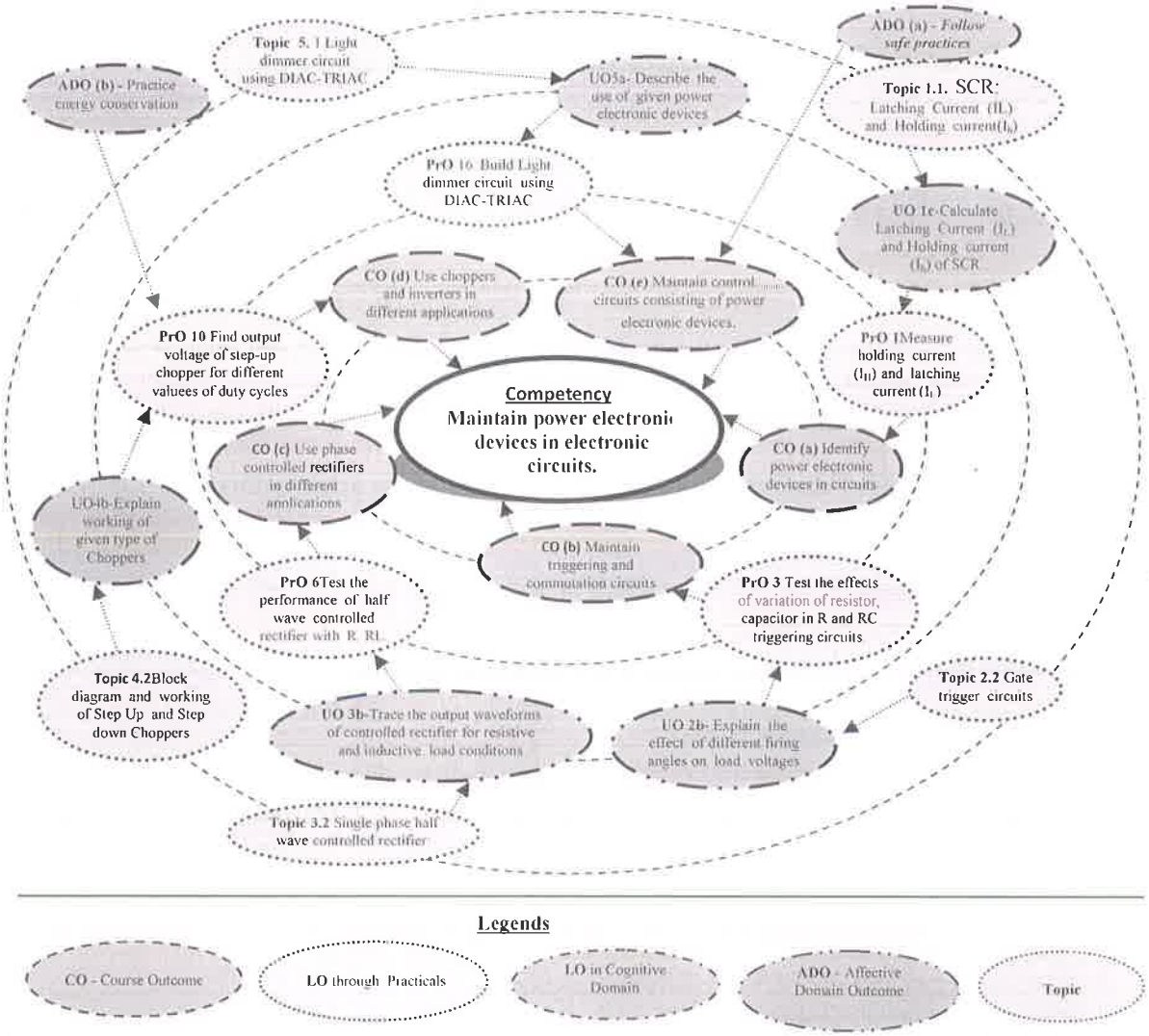

Figure 1 - Course Map

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 Exercises(PrOs)	Unit No.	Approx. Hrs. Required
1	Measure holding current (I_H) and latching current (I_L) of a given SCR from its V-I characteristic curve.	I	2*
2	Test the performance of given IGBT.	I	2*
3	Determine break over voltage of given DIAC from its V-I curve.	II	2
4	Test the effect of variation of resistor, capacitor in R and RC triggering circuits of firing angle of SCR.	II	2
5	Test the effects of variation of R on firing angle in synchronized UJT triggering circuit.	II	2
6	Test the performance of Class C-Complimentary type commutation circuit.	III	2*
7	Test the performance of half wave controlled rectifier with R, RL	III	2*

S. No.	Practical Exercises(PrOs)	Unit No.	Approx. Hrs. Required
	load and measure load voltage.		
8	Determine firing angle and output voltage of 3- phase half wave controlled rectifier using Delta-star transformer.	III	2*
9	Test the performance of full wave controlled rectifier with R, RL load and measure load voltage.	IV	2
10	Find output voltage of step-up chopper for different values of duty cycles.	IV	2
11	Test parallel inverter to the measure frequency and output voltages.	IV	2
12	Measure output voltages of step-down chopper for different values of duty cycles. Part I	IV	2*
13	Measure output voltages of step-down chopper for different values of duty cycles. Part II	IV	2*
14	Build/test SMPS for mobile phone charging. Part I	IV	2
15	Build/test SMPS for mobile phone charging. Part II	V	2
16	Build Light dimmer circuit using TRIAC test the effect of resistance variation on intensity of lamp.	V	2*
	Total		**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the 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
- 'Organizing Level' in 2nd year
- 'Characterizing 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	Power scope: dual channel, dual trace,5Mhz,max .voltage 1000vp-p	4,6,8,9, 11-16
2	TONG Tester for ac line current measurement up to 100A	7
3	CRO:20 MHz with color display , dual channel, ac voltage 750v max	6-8
4	Digital Tachometer- non – contact type up to 2000rpm	Micro project
5	LCR Q meter Accurate 0.01% - up to 5 MHz	3,5,1
6	Multiple output DC regulated power supply: 0-30V,0-100V,0-300V up to 2A	1,2,10
7	Function generator: DC to 10 MHz , max output 0-30Vp-p, sine, triangle, square wave function within build counter.	10
8	Single phase DIMMERSTAT :0-300Vac,5A	6-8
9	Digital meter for DC voltage measurement up to 700V, DC current measurement up to 10A	1,2
10	Desktop PC, 32GHz with multimedia features, LED monitor	Micro project

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 Thyristor Family Devices	1a. Explain with sketches the working of the given type of thyristor device. 1b. Interpret V-I characteristics of the given power electronic device. 1c. Calculate latching current (I_L) and holding current (I_h) for the given type of SCR. 1d. Select relevant triggering device for the given circuit with justification. 1e. Identify various power electronic	1.1 SCR: Construction, operating Principle with Two transistor analogy, V-I characteristics, latching current (IL) and holding current(I_h), applications of SCR 1.2 Thyristor family devices: LASCR, SCS, GTO and TRIAC, power MOSFET, IGBT : Construction, operating principle, V-I characteristics and applications 1.3 Triggering devices- UJT, PUT,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	devices along with their specifications. 1f. Describe with sketches the procedure to troubleshoot the simple given type of thyristor circuit	SUS, SBS and DIAC: Construction, operating Principle, V-I characteristics and applications
Unit– II Turn ON and Turn OFF methods of SCR	2a. Describe the turn-ON mechanism of the given SCR circuit. 2b. Explain with sketches the effect of the given firing angles on load voltages. 2c. Explain with sketches the methods of triggering for the given SCR. 2d. Explain with sketches the turn OFF method of the given SCR. 2e. Explain with sketches the working of protection circuits for the given SCR against over voltage, over current. 2f. Describe with sketches the procedure to troubleshoot the simple given type of thyristor turn-ON/OFF circuit.	2.1 Concept of turn ON mechanism of SCR: High voltage thermal triggering, illumination triggering, dv/dt triggering, gate triggering of SCR. 2.2 Gate trigger circuits : resistance triggering circuit, resistance, capacitance triggering circuit 2.3 SCR triggering Method: UJT/ PUT-relaxation oscillator circuit , synchronized UJT triggering circuit, pulse transformer and optocoupler (MCT2E) 2.4 Turn OFF methods : Class A-series resonant commutation circuit, class B-Shunt resonant commutation circuit, class C-Complimentary Symmetry commutation circuit 2.5 Protection circuits of SCR: over voltage, over current, snubber circuit and crowbar
Unit– III Phase controlled Rectifiers	3a. Explain with sketches the effect of change in firing angle on output current of the given rectifier considering concept of phase control. 3b. Interpret the output waveforms of the given phase controlled rectifier for given load condition. 3c. Calculate load voltage and load current of the given controlled rectifier. 3d. Explain effect of the given load on the output of the given controlled rectifier. 3e. Describe with sketches the procedure to troubleshoot the simple given type of phase controlled rectifier	3.1 Phase control parameters: Firing angle (**α**) and conduction angle (**Ø**) 3.2 Single phase half wave controlled rectifier: circuit diagram , working and waveforms with R and RL load, effect of freewheeling diode with RL load 3.3 Single phase centre tapped full wave controlled rectifier : circuit diagram , working and waveforms with R and RL load, effect of freewheeling diode with RL load 3.4 Basic three phase half wave controlled rectifier

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-IV Choppers and Inverters	4a. Explain the working of the given Choppers with sketches and formulae. 4b. Explain with sketches the working of the given type of inverter circuit. 4c. Select the chopper and inverter for the given application. 4d. Describe with sketches the procedure to troubleshoot the simple given type of Chopper/Inverter	4.1 Convertors and its types 4.2 Block diagram and working of step up and step down choppers using power MOSFET 4.3 Inverters: circuit diagram, working of series inverter, parallel inverter
Unit –V Industrial applications of power electronic devices	5a. Describe the use of power electronic device in the given industrial circuit. 5b. Identify industrial control circuit in the given PCB. 5c. Describe the performance of the given Industrial control circuit. 5d. Explain with sketches the working of the given type of UPS 5e. Describe with sketches the procedure to troubleshoot the given power electronic application such as the UPS/SMPS and others.	5.1 Light dimmer circuit using DIAC-TRIAC 5.2 Battery charger using SCR 5.3 Emergency lighting system 5.4 Temperature controller using SCR 5.5 Block diagram and concept of UPS (on line and off line) 5.6 Block diagram and concept of SMPS

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

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	Thyristor Family Devices	12	4	6	8	18
II	Turn ON and Turn OFF methods of SCR	10	4	4	6	14
III	Phase controlled Rectifiers	10	2	4	8	14
IV	Choppers and Inverters	10	2	4	8	14
V	Industrial Applications of power electronic devices	06	2	2	6	10
Total		**48**	**14**	**20**	**36**	**70**

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

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. Guide student(s) in undertaking micro-projects.
f. Use PPTs to explain the construction and working of various power electronic devices.
g. Use PPTs to explain the construction and working of controlled rectifiers.
h. Guide students to use data manuals.
i. Deliver seminar on related topic.
j. Prepare industrial visit report with reference to specification, uses of power electronics application.

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.

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

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

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Power Electronics	Moorthi, V.R.	Oxford University Press , New Delhi 110001, 2013, ISBN 0-19-567092-2
2	Fundamentals of Power Electronics	Bhattacharya, S. K.	ISTE Learning materials centre,2006 , ISBN 9788125918530
3	Power Electronics Essentials and Applications	Umanand, L	Wiley India Pvt. Ltd, New Delhi, 2011, ISBN :9788126519453
4	Power Electronics Circuits Devices and Applications	Rashid, Muhammad H.	Pearson Education India, New Delhi, 2012,ISBN: 9780133125100
5	SCR Manual Including TRIACS and other thyristors (6th Edition)	General Electric(Author)	General Electric Co,2007, ISBN:9780137967636

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.nptel.ac.in/courses /108101038
b. PSIM software for power electronics
c. www.en.wikibooks.org/wiki/Power_Electronics
d. www.books.google.co.in/books/about/Power_Electronics

Program Name : **Diploma in Electronics and Telecommunication Engineering**

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

Semester : **Fourth**

Course Title : **Digital Communication Systems**

Course Code : **22428**

1. RATIONALE

Communication technologies have undergone radical changes, especially due to convergence of computers and communication.No industry is untouched by the digital communication.This course will enable the diploma engineers to apply facts, concepts and working principles of Digital commincation for the troubleshooting and maintenance of digital communication system. This course is intended to develop the skills to diagnose and rectify the errors occure in Digital communication system. The concepts and principles of digital communication will also lay the foundation to understand the various modern communication systems.

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 digital 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. Analyse various error detection and correction codes in digital communication systems
b. Use various pulse code modulation techniques
c. Maintain systems based on digital modulation techniques.
d. Multiplex and demultiplex digital signals.
e. Maintain spread spectrum based systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	4	8	3	70	28	30*	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.

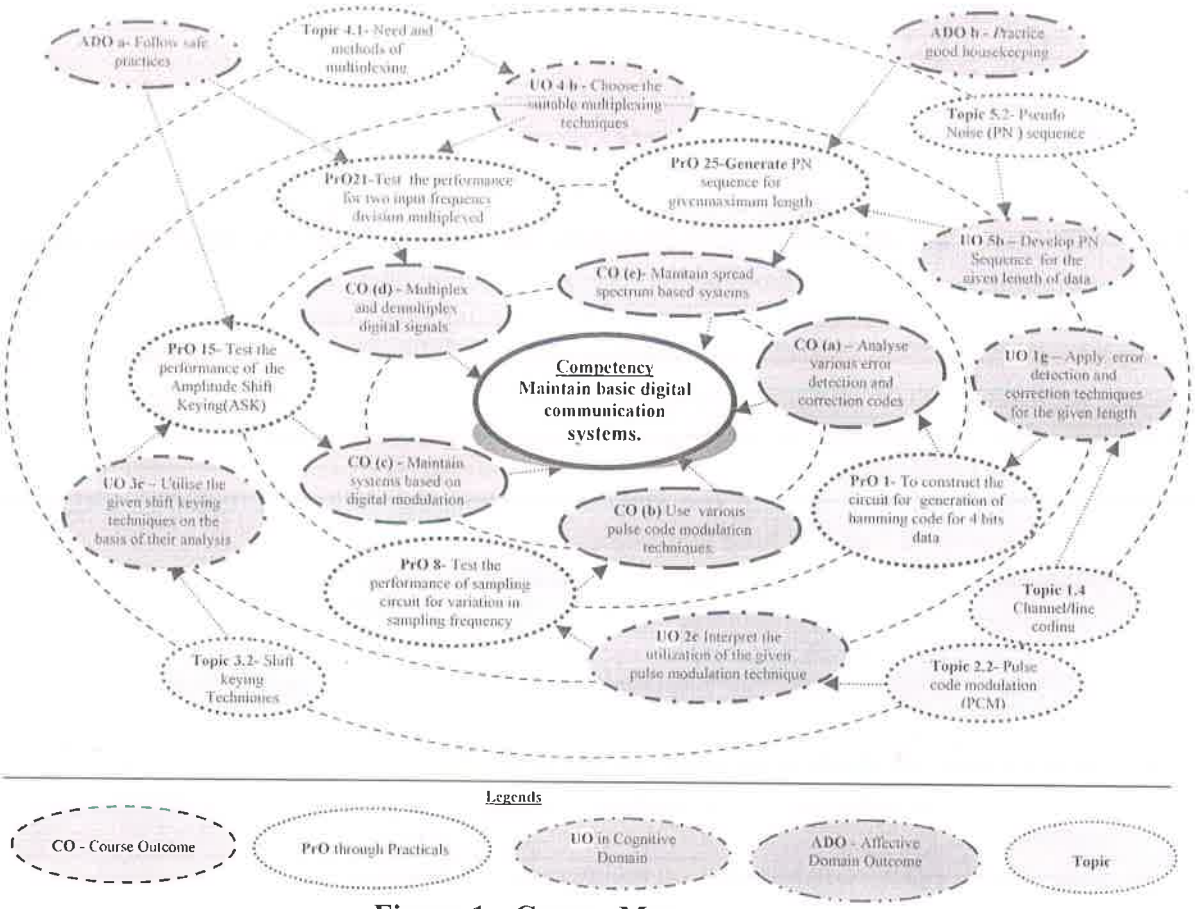

Figure 1 - Course Map

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	To construct the circuit for Generation of hamming code for 4 bits data.	I	02*
2	To construct the circuit for one bit error correction using hamming code.	I	02*
3	Generate: (a) Unipolar –NRZ, RZ (b) Bipolar- NRZ (AMI), Manchester for given data.	I	02
4	Observe the effect of average DC value and bit duration for unipolar non return zero(UPNRZ) and polar return zero(PRZ).	I	02
5	Detect error by VRC techniques using relevant simulation tool.	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6	Detect error by LRC techniques using relevant simulation tool.	I	02*
7	Test the performance of natural and flat top sampling circuit.	I	02*
8	Test the performance of sampling circuit for variation in sampling frequency.	II	02
9	Test the performance of the Pulse Code modulator/ demodulator circuit.	II	02*
10	Test the performance of the delta modulator/ demodulator circuit. .	II	02
11	Test the performance of the adaptive delta modulator/ demodulator circuit..	II	02
12	Test the performance of the differential pulse code modulator (DPCM) modulator/ demodulator circuit..	II	02*
13	Write a program using a relevant simulation tool to observe sampling process for sampling rate less than, equal to and greater than the Nyquist rate.	II	02
14	Test the performance of the Amplitude Shift Keying(ASK) modulator / demodulator circuits.	II	02*
15	Test the performance of the Amplitude Shift Keying(ASK) using relevant simulation software.	III	02
16	Test the performance of the Binary Phase Shift Keying(BPSK) Modulator and Demodulator circuits.	III	02*
17	Test the performance of Frequency Shift Keying(FSK) Modulator and Demodulator circuits.	III	02
18	Test the performance of the Differential Phase shift keying(DPSK) modulator / demodulator circuits.	III	02*
19	Test the performance of Quadrature Phase shift keying(QPSK) modulator and demodulator circuits.	III	02
20	Test the performance of Quadrature Amplitude Modulation (QAM) modulator and demodulator circuits.	III	02
21	Test the performance for 4-input time division multiplexing circuit.	IV	02*
22	Test the performance for 2- input frequency division multiplexing (FDM) circuit.	IV	02*
23	Generate a TDM signal using relevant simulation software.	IV	02
24	Generate a FDM signal using relevant simulation software.	IV	02
25	Generate PN sequence for given maximum length.	IV	02
26	Generate PN sequence for given maximum length using relevant simulation software.	IV	02
27	Generate two channel CDMA-DSSS signal and demodulate it.	IV	02*
28	Generate two channel CDMA-FHSS signal and demodulate it.	V	02
	Total		**56**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practicals 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	CRO – Dual trace, 50 MHz and above bandwidth, component tester	1 to 28
2	Spectrum analyzer, 9 kHz to 1.5 GHz Frequency range, Typical -135 dBm Displayed Average Noise Level (DANL)	20-28
3	Function Generator: Frequency Range 0.1 Hz to 30MHZ.	1 to 28
4	RF generator/wideband oscillator Wide Frequency Range 100 KHz to 150 MHz	20-28
5	Digital Communication Trainer, In-built internal data generator, Type of Modulations and Demodulations:Sampling, Line coding, PCM,DPCM,DM,ADM, ASK, FSK, BPSK,DPSK, QPSK, QAM,TDM,FDM,TDMA,FDMA,CDMA,FHSS,DSSS	2 to 28

S. No.	Equipment Name with Broad Specifications	PrO. No.
6	Digital storage oscilloscope, 50MHz and above,dual trace,component tester	20 -28

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 Digital Communication System and Coding Methods	1a. Explain function of the given block of digital communication system. 1b. Describe with sketches the given type of characteristics of communication channels. 1c. Determine the channel capacity for the given channel noise level. 1d. Construct a Huffman code for the given 'n' bit data. 1e. Interpret Shannon Hartley Theorem for the given sampling rate. 1f. Compare the given line codes on the basis of average DC value, bit period, bandwidth. 1g. Apply error detection and correction techniques for the given length of data bits to generate the coded data. 1h. Describe the procedure to troubleshoot the specified digitial communication equipment	1.1 Elements of Digital Communication system with its block diagram: source, channel, ,transmitter, receiver advantages and disadvantages of digital communication 1.2 Communication channel characteristics :bit rate, baud rate, bandwidth, repeater distance, applications 1.3 Concept of Entropy and Information rate,channel capacity : Hartley's law, Shannon Hartley's theorem, Source coding: Huffman coding 1.4 Channel/line coding : Error, causes of error and its effect ,error detection and correction using parity, checksum, Vertical redundancy Check (VRC) , Longitudinal Redundancy Check (LRC), Cyclic Redundancy Check(CRC), Linear block code,Hamming code 1.5 Line coding formats: Classification of line codes,Uni polar- RZ, RZ,NRZ-I,NRZ-L,Polar -NRZ and RZ,Bipolar-NRZ /AMI, RZ,Manchester -Split Phase and Differential Manchester, Polar quaternary and their waveforms
Unit-II Pulse Code Modulation Techniques	2a. Explain sampling and quantization process for the given 'q' levels of quantization. 2b. Calculate sampling frequency for the given frequency of signals. 2c. Interpret the utilization of bandwidth for the given pulse modulation technique. 2d. Compare the performance of the given types of pulse	2.1 Sampling and quantization process: types of sampling,Nyquist sampling theorem (only statement), Aliasing effect,Quantization process , Quantization error/noise, Companding 2.2 Pulse code modulation (PCM), Differential pulse code modulation (DPCM): Transmitter and Receiver block diagram and its working, advantages and disadvantages 2.3 Delta Modulation (DM): Block diagram of Transmitter and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	modulation techniques. 2e. Describe the procedure to troubleshoot the specified pulse code modulation circuit.	Receiver,slope overload and Granular noise, Advantages and disadvantages of DM 2.4 Adaptive Delta modulation (ADM): Transmitter and Receiver block diagram. advantages and disadvantages of ADM
Unit– III Digital Modulation Techniques	3a. Summarise the given types of shift keying techniques. 3b. Explain generation of the given type of shift keying signals. 3c. Utilise the given shift keying techniques on the basis of their analysis. 3d. Interpret the constellation diagram for the given keying signals. 3e. Compare the salient features of the given types of digital modulation techniques for the following: bandwidth requirement, SNR, detection method. 3f. Describe the procedure to troubleshoot the specified digital modulation circuit	3.1 Types of Digital modulation techniques and their advantages, concept of Coherent and Non coherent detection 3.2 Shift keying Techniques : Amplitude Shift Keying (ASK) Frequency shift keying (FSK), Phase shift keying (PSK), Differential Phase shift keying (DPSK), Quadrature Phase shift keying (QPSK), Constellation diagram , transmitter and receiver block diagram and their working with waveforms 3.3 M-ary encoding :Need, M-ary FSK and M-ary PSK 3.4 Quadrature amplitude Modulation(QAM): Need, transmitter and receiver block diagram and their working with waveforms, Constellation diagram
Unit– IV Multiplexing and Multiple Access Techniques	4a. Classify the given multiplexing techniques on the basis of domain of working. 4b. Choose the suitable multiplexing techniques for multiplexing the given number of signals. 4c. Interpret the given multiplexing hierarchy. 4d. Contrast the given type of multiplexing techniques and multiple access techniques. 4e. Describe the procedure to troubleshoot the specified multiplexing circuit.	4.1 Need and methods of multiplexin: Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Code Division multiplexing (CDM), definition, block diagram and their comparison 4.2 E and T- carrier multiplexing hierarchy 4.3 Access techniques :Need and methods- Time Division Multiple Access (TDMA), Frequency Division multiple Access (FDMA), Code Division Multiple access (CDMA)
Unit –V Spread Spectrum Modulation	5a. Interpret the aspects of spread spectrum (SS) Modulation for the given application. 5b. Develop PN Sequence for the given length of data bits.	5.1 Introduction to spread spectrum (SS) Modulation: advantages over fixed frequency, applications of SS modulation. block diagram of Spread Spectrum modulation system

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	5c. Interpret the given spread spectrum Modulation technique. 5d. Compare the performance of the fast and slow frequency hopping on the basis of given parameters.	5.2 Pseudo Noise (PN) sequence: definition, generation and maximum length sequence 5.3 Types of SS Modulation: Direct sequence spread spectrum signal (DSSS)and Frequency hopped spread spectrum (FHSS)

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

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	Digital Communication System and Coding Methods	16	06	08	04	18
II	Pulse Code Modulation Techniques	16	04	08	04	16
III	Digital Modulation Techniques	16	04	04	08	16
IV	Multiplexing and Multiple Access Techniques	10	04	04	04	12
V	Spread Spectrum Modulation	06	02	02	04	08
Total		**64**	**20**	**26**	**24**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: *This specification table provides general guidelines to assist students 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 behavior.

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. 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.

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.

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

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

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Communication systems	Tomasi, Wayne	Pearson Education, Delhi, 2009, ISBN: 9788131719534
2	Digital Communication	Rao. Ramakrishna P.	McGraw Hill,Delhi, 2011, ISBN: 9780070707764

S. No.	Title of Book	Author	Publication
3	Data Communication and Networking	Forouzan, Behrouz	McGraw Hill, Delhi, 2013, ISBN: 9781259064753
4	Digital Communication	Sklar, Bernald	Pearson Education India, Delhi,Second Edition, 2014, ISBN: 9781292026060

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. Hamming code:- https://www.youtube.com/watch?v=1A_NcXxdoCc
b. Information theory :-https://www.youtube.com/watch?v=nvmo9voRiSs
c. Video lecture:- www.nptelvideos.in/communication engineering.
d. Digital Modulation technique:-https://www.youtube.com/watch?v=GLnGVB92K78
e. Multiple access:-https://www.youtube.com/watch?v=vtiup1w1c4E
f. Multiple access:-https://www.youtube.com/watch?v=AKXFwwcww_E
g. CDMA:-https://www.youtube.com/watch?v=vdbc9P3U-Xo
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