Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name : Diploma In Digital Electronics / Electronics & Tele-communication Engg. / Electronics & Communication Engg. / Electronics Engineering / Industrial Electronics

Programme Code : DE / EJ / ET / EX / IE **With Effect From Academic Year** : 2023-24

Duration Of Programme : 6 Semester **Duration** : 16 WEEKS

Semester : Fourth **NCrF Entry Level : 3.5** **Scheme** : K

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment / Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL Practical				Based on Self Learning		Total Marks
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																								
1	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	314301	2	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	DIGITAL COMMUNICATION SYSTEMS	DCS	DSC	314326	-	4	-	4	2	10	5	3	30	70	100	40	50	20	25#	10	25	10	200
3	CONSUMER ELECTRONIC SYSTEMS	CEL	DSC	314327	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
4	MICROCONTROLLER & APPLICATIONS	MAA	DSE	314328	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
5	BASIC POWER ELECTRONICS	BPE	DSC	314363	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175
6	ELECTRONIC EQUIPMENT MAINTENANCE & SIMULATION	MEE	SEC	314009	-	-	-	4	-	4	2	-	-	-	-	-	25	10	25@	10	-	-	50
Total					**2**	**16**		**18**	**6**		**20**		**150**	**350**	**500**		**150**		**125**		**125**		**900**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures/**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX**
Semester	**: Fourth**
Course Title	**: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY**
Course Code	**: 314301**

I. RATIONALE

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.
- CO5 - Implement the environmental policies under the relevant legal framework.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course	Course Title	Abbr	Course	Learning Scheme	Credits	Assessment Scheme

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Code			Category/ s	Actual Contact Hrs./ Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 2 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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Note :

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2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the need of studying environment and its components. TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change TLO 1.5 Explain the concept of zero carbon-footprint with carbon credit	**Unit - I Environment and climate change** 1.1 Environment and its components, Types of Environments, Need of environmental studies 1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization 1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste 1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on Climate Change in Indian perspectives 1.5 Zero Carbon footprint for sustainable development, (IKS-Enviornment conservation in vedic and pre-vedic India)	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Justify the importance of natural resources in sustainable development TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability	**Unit - II Sustainability and Renewable Resources** 2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS-	Lecture Using Chalk-Board Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	TLO 2.3 Differentiate between renewable and non-renewable sources of energy TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues	Concepts of Panchmahabhuta) 2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources 2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel 2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy & Tidal energy	
3	TLO 3.1 Explain the characteristics and functions of ecosystem TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability TLO 3.3 Describe biodiversity assessment initiatives in India TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India TLO 3.5 Explain the need of conservation of biodiversity in the given situation	**Unit - III Ecosystem and Biodiversity** 3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem 3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity 3.3 Biodiversity Assessment Initiatives in India 3.4 SWOT analysis of biodiversity hot spot in India 3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Classify the pollution based on the given criteria TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms TLO 4.5 Compare the noise level from different zones of city with justification TLO 4.6 Describe the roles and responsibilities of central and state pollution control board	**Unit - IV Environmental Pollution** 4.1 Definition of pollution, types- Natural & Artificial (Man- made) 4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation 4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation 4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential area 4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city 4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities	Lecture Using Chalk-Board Presentations
5	TLO 5.1 Explain Constitutional provisions related to environmental protection TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental	**Unit - V Enviornmental legislation and sustainable practices** 5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts 5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs 5.3 Green technologies like solar desalination,	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	problem TLO 5.4 Explain the role of information technology in environment protection	green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging 5.4 Role of information technology in environment protection and human health	

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

•
Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution
Draft an article on India’s Strategies to progress across the Sustainable Development Goals
Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each source
Conduct the SWOT analysis of biodiversity hotspot in India
Prepare a mind-mapping for the zero carbon footprint process of your field
Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions
Any other assignment on relevant topic related to the course suggested by the facilitator

UNICEF Certification(s)

• Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal www.mahayouthnet.in . The course encompasses five Modules in the form of Units as given below: -
Unit 1: Living with climate change
Unit 2 : Water Management and Climate Action
Unit 3: Energy Management and Climate Action
Unit 4 : Waste Management and Climate Action
Unit 5 : Bio-cultural Diversity and Climate Action
If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

Micro project

•
Technical analysis of nearby commercial RO plant.
Comparative study of different filters used in Household water filtration unit
Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainabilityand cost-benefit
IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion
Visit a local polluted water source and make a report mentioning causes of pollution
Any other activity / relevant topic related to the course suggested by the facilitator

Activities

•
Prepare a report on the working and functions of the PUC Center machines and its relavance in pollution control.
Prepare and analyse a case study on any polluted city of India
Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local

authority
Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers
Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool
Watch a video related to air pollution in India and present the summary
Any other assignment on relevant topic related to the course suggested by the facilitator

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Nil	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Enviornmental legislation and sustainable practices	CO5	7	4	4	4	12
Grand Total				**45**	**20**	**24**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests (MCQs) of 30 marks will be conducted and average of two-unit tests considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as UNICEF Certification(s)/Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

Summative Assessment (Assessment of Learning)

- Online MCQ type Exam

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes	Programme Outcomes (POs)	Programme Specific

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

(COs)								Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	-	1	-	-	3	2	3			
CO2	-	2	2	-	3	2	3			
CO3	-	-	-	-	3	1	2			
CO4	1	-	-	-	3	2	2			
CO5	1	-	2	-	3	2	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Enviornmental science	APH Publishing New Delhi (ISBN 978-8176485906)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://sdgs.un.org/goals	United Nation’s website mentioning Sustainability goals
2	http://www.greenbeltmovement.org/news-and-events/blog	Green Belt Movement Blogs on various climatic changes and other issues
3	http://www.greenbeltmovement.org/what-we-do/tree-planting-fo r-watersheds	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques
4	https://www.youtube.com/ @ierekcompany/videos	International Experts For Research Enrichment and Knowledge Exchange –IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	www.mahayouthnet.in	UNICEF Intiative for youth leadership for climate action
6	https://eepmoefcc.nic.in/index1.aspx? lsid=297&lev=2&lid=1180 &langid=1	GOI Website for public awareness on enviornmetal issues
7	https://egyankosh.ac.in/ handle/123456789/61136	IGNOU's Intiative for online study material on Enviornmental studies
8	https://egyankosh.ac.in/ handle/123456789/50898	IGNOU's Intiative for online study material on sustainability
9	https://sustainabledevelopment.un.org/ content/documents/1180 3Official-List-of-Proposed-SDG-Indicators.pdf	Final list of proposed Sustainable Development Goal indicators

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

Sr.No	Link / Portal	Description
10	https://sustainabledevelopment.un.org/memberstates/india	India's Strategies to progress across the SDGs.
11	https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html	Challenges to Sustainable Development
12	https://nptel.ac.in/courses/109105190	NPTEL course on sustainable development
13	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	Swayam Course on Enviornmetal studies (Natural Resources, Biodiversity and other topics)
14	https://onlinecourses.nptel.ac.in/noc23_hs155/preview	NPTEL course on enviornmental studies which encomopasses SDGs, Pollution, Cliamate issues, Energy, Policies and legal framework
15	https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf	SWOT analysis of Biodiversity
16	https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf	Central sanskrkit university publication on Vedic and pre vedic enviornmetal conservation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

DIGITAL COMMUNICATION SYSTEMS **Course Code : 314326**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE**
Semester	**: Fourth**
Course Title	**: DIGITAL COMMUNICATION SYSTEMS**
Course Code	**: 314326**

I. RATIONALE

Digital communication technology is widely used across various sectors for instant and efficient information exchange. Digital communication course is instrumental in preparing students for the challenges and opportunities of the digital age. It equips them with essential skills and knowledge that are increasingly relevant in today's interconnected and technology-driven world. In this course basic concept of digital communication are covered to handle all the challenges of communication industries.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain following industry/employer excepted outcome through various teaching learning experiences:
Use basic concept of digital communication in various applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Implement different error control coding schemes for digital communication system.
- CO2 - Use various pulse code modulation techniques.
- CO3 - Analyze performance of different digital modulation techniques.
- CO4 - Interpret concept of multiplexing and multiple access techniques.
- CO5 - Interpret the concept of various spread spectrum techniques.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./ Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314326	DIGITAL COMMUNICATION SYSTEMS	DCS	DSC	4	-	4	2	10	5	3	30	70	100	40	50	20	25#	10	25	10	200

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
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5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
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V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe elements of digital communication system with its block diagram. TLO 1.2 Calculate entropy for a given data using concept of entropy. TLO 1.3 Construct the Huffman code for the given 'n' bit data. TLO 1.4 Apply the error detection and correction technique for the given length of data bit to generate data. TLO 1.5 Compare the given line codes.	**Unit - I Digital Communication System and Coding Methods** 1.1 Elements of basic digital communication system with its block diagram: Source encoder and decoder, Channel encoder and decoder, modulator and demodulator, Advantages and disadvantages of digital communication 1.2 Communication channel characteristics: bit rate, baud rate, bandwidth, repeater distance 1.3 Concept of entropy and information rate, channel capacity: Hartley's law and Shannon-Hartley theorem for channel capacity, Source coding: Huffman coding 1.4 Error detection codes: Vertical Redundancy Check (VRC) code, Longitudinal Redundancy Check (VRC) code, Cyclic Redundancy Check (CRC) code and Checksum code 1.5 Error correction codes: Linear block code-calculation of minimum Hamming distance, error detection capability, error correction capability, Hamming code generation 1.6 Line coding: Need, properties, Unipolar RZ and NRZ, Polar RZ and NRZ, Bipolar NRZ (AMI), split phase and differential Manchester, Polar quaternary and their waveforms	Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Compare natural and flat top sampling. TLO 2.2 Calculate the sampling frequency for given signal. TLO 2.3 Compare the performance of the given type of pulse modulation technique. TLO 2.4 Describe working of pulse code modulation transmitter and receiver.	**Unit - II Pulse Code Modulation Techniques** 2.1 Sampling & quantization process: Nyquist sampling theorem, types of sampling (natural & flat top sampling), aliasing effect, quantization process, quantization error, companding 2.2 PAM, PWM, PPM: Block diagram of transmitter and receiver with its working principle 2.3 Pulse code modulation (PCM), Differential pulse code modulation (DPCM) : Block diagram of transmitter and receiver with its working principle, Advantages and disadvantages 2.4 Delta modulation (DM): Block diagram of transmitter and receiver with its working principle, slope overload, granular noise. Advantages and disadvantages 2.5 Adaptive Delta modulation (ADM): Block diagram of transmitter and receiver with its working principle, Advantages and disadvantages 2.6 Comparison of pulse code modulation with continuous wave modulation	Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 Compare coherent and noncoherent detection technique. TLO 3.2 Describe the generation of given type of	**Unit - III Digital Modulation Techniques** 3.1 Types of digital modulation techniques and their advantages, concept of coherent and non-coherent detection 3.2 Shift keying techniques: Block diagram of transmitter	Chalk-Board Presentations Visit to communication industry

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	shift keying signal. TLO 3.3 Write process of multiple data transfer using M-ary FSK and M-ary PSK. TLO 3.4 Draw the constellation diagram for given keying signals. TLO 3.5 Compare the salient feature of the given types of digital modulation techniques.	and receiver with its working principle for Amplitude Shift Keying (ASK), Frequency Shift keying (FSK), Phase Shift keying (PSK), Differential Phase Shift keying (DPSK), Quadrature Phase Shift keying (QPSK), constellation diagram and waveforms 3.3 M-ary encoding: Need, M-ary FSK and M-ary PSK 3.4 Quadrature amplitude modulation (QAM): Need, Block diagram of transmitter and receiver with its working principle, constellation diagram	
4	TLO 4.1 Describe the working principle of given type of multiplexing technique. TLO 4.2 Choose the suitable multiplexing techniques for multiplexing the given number of signal. TLO 4.3 Classify with proper justification the given multiple access techniques on the basis of domain of working. TLO 4.4 Compare CDMA, TDMA, FDMA on basis of given parameters.	**Unit - IV Multiplexing and Multiple Access Technique** 4.1 Multiplexing: Need,Block diagram of transmitter and receiver with its working principle for Time Division Multiplexing(TDM), Frequency Division Multiplexing (FDM), Code Division Multiplexing(CDM) 4.2 Multiple Access techniques: Need, Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA), Advantages of TDMA over FDMA	Chalk-Board Presentations Visit to communication industry
5	TLO 5.1 Interpret the aspect of spread spectrum (SS) modulation for the given application. TLO 5.2 Generate the PN sequence for the given length of data bits. TLO 5.3 Explain jamming margin, processing gain and Eb/No ratio. TLO 5.4 Compare the performance of the fast and slow frequency hopping on the basis of given parameter.	**Unit - V Spread Spectrum (SS) Modulation** 5.1 Introduction to spread spectrum modulation: Advantages over fixed frequency, application of spread spectrum modulation, model of spread spectrum modulation system 5.2 Pseudo-noise (PN) sequences: Definition, generation and maximum length sequence. 5.3 Types of SS modulation: Direct sequence spread spectrum (DSSS), jamming margin, processing gain, Eb/No ratio, Frequency hopped spread spectrum, slow and fast frequency hopping.	Chalk-Board Presentations Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Observe line code for given data. LLO 1.2 Measure amplitude for various line code	1	*Generate- a)Unipolar-NRZ, RZ b)Bipolar- NRZ(AMI), Manchester Code for given data	2	CO1
LLO 2.1 Observe changes in output of various line coding scheme.	2	Implemention of various line coding scheme using suitable simulation tool	2	CO1

DIGITAL COMMUNICATION SYSTEMS **Course Code : 314326**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Generate even parity for given data sequence.	3	Determine error by LRC techniques using suitable simulation tool	2	CO1
LLO 4.1 Generate odd parity for given data sequence.	4	*Determine error by VRC techniques using suitable simulation tool	2	CO1
LLO 5.1 Calculate the 7 bit hamming code for given 4 bit data. LLO 5.2 Observe connections between the data lines.	5	*Generation of hamming code for 4 bit data	2	CO1
LLO 6.1 Determine the position of error in given data. LLO 6.2 Correct the detected error.	6	Error correction using hamming code	2	CO1
LLO 7.1 Build connection of natural and flat top smapling circuit. LLO 7.2 Illustrate the diffrence observed in waveforms of natural and flat top sampled signal.	7	*Generation of natural and flat top sampling signal	2	CO2
LLO 8.1 Analyze Nyquist implications on signal generation and reconstruction.	8	Determine the Nyquist rate for given signal by using suitable simulation tool	2	CO2
LLO 9.1 Generate modulated and demodulated signal on DSO. LLO 9.2 Measure width of pulses according to input data.	9	*Performance of pulse width modulation and demodulation circuit	2	CO2
LLO 10.1 Determine the position of pulses as per change in input signal.	10	*Performance of pulse position modulation and demodulation circuit	2	CO2
LLO 11.1 Determine output binary data as per input data.	11	Generation of pulse signal using pulse code modulation	2	CO2
LLO 12.1 Generate and verify the DPCM signal using simulation software.	12	Implement differential pulse code modulation and demodulation by using suitable simulation tool	2	CO2
LLO 13.1 Observe and verify delta modulated and demodulated signal.	13	*Generation of delta modulation and demodulation signal	2	CO2
LLO 14.1 Observer how quantization error is removed in ADM. LLO 14.2 Measure the quantization error.	14	*Performance of adaptive delta modulation and demodulation circuit	2	CO2
LLO 15.1 Measure amplitude level of output signal according to binary data.	15	*Transmit and receive digital signal using Amplitude shift keying	2	CO3
LLO 16.1 Build connection for FSK kit. LLO 16.2 Observe demodulated signal as pers transmitted binary data.	16	*Transmit and receive digital signal using Frequency Shift Keying	2	CO3
LLO 17.1 Measure the phase shift according to binary data.	17	*Transmit and receive digital signal using Phase Shift Keying	2	CO3
LLO 18.1 Verify the transmitted digital signal according to the original binary data using QPSK modulation. LLO 18.2 Measure the phase shifts corresponding to the binary data.	18	Performance of QPSK modulation and demodulation	2	CO3
LLO 19.1 Measure the amplitude and phase shifts according to the binary data. LLO 19.2 Observe the transmitted signal in the time domain and frequency domain.	19	Performance of QAM modulation and demodulation	2	CO3
LLO 20.1 Build connection for TDM circuit. LLO 20.2 Measure the amplitude and	20	Multiplexing of signals in TDM using kit	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
frequency of TDM signal.				
LLO 21.1 Use simulation software to visualize the TDM signal. LLO 21.2 Determine the bandwidth and data rate of the TDM signal.	21	*Generation of TDM signal using suitable simulation software	2	CO4
LLO 22.1 Build connection for FDM kit. LLO 22.2 Measure frequency of FDM signal.	22	*Multiplexing of signals in FDM using kit	2	CO4
LLO 23.1 Use simulation software to visualize the FDM signal	23	Generation of FDM signal using suitable simulation software	2	CO4
LLO 24.1 Use simulation software to visualize the CDM signal.	24	*Generation of CDM signal using suitable simulation software	2	CO4
LLO 25.1 Select desired maximum length N for the PN sequence. LLO 25.2 Obtain the output bits of the PN sequence.	25	*PN sequence generator	2	CO5
LLO 26.1 Determine PN sequence.	26	Generation of PN sequence using suitable simulation tool	2	CO5
LLO 27.1 Observe CDMA signal with the spreading sequences for each channel. LLO 27.2 Recover original message signal from modulated signal.	27	*Generation of two channel CDMA-DSSS signal using suitable simulation tool	2	CO5
LLO 28.1 Modulate the data using spreading sequences for each channel. LLO 28.2 Recover original message signal from modulated signal.	28	Generation of two channel CDMA-FHSS signal using suitable simulation tool	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare seminar on how IoT relies on digital communication.
- Build a circuit to generate FSK signal.
- Build circuit to generate hamming code.
- Build sampling circuit.
- Build a circuit to generate PPM signal.
- Build a circuit to generate ASK signal.
- Build a circuit to generate PWM signal.
- Prepare report to evaluate the importance of low-latency communication in real-time AI application.
- Investigate the applications of digital communication in healthcare, including telemedicine and remote patient monitoring.
- Prepare presentation on 5G and its impact on digital communication.

Visit

- Visit nearby communication industry like BSNL/Airtel/Jio etc. and prepare report on techniques used for modulation demodulation.

Assignment

- Construct the hamming code for the data 1010 with odd parity.
- The probabilities of five source messages are m1 = 0.2, m2 = 0.3, m3 = 0.2, m4 = 0.15 and m5 = 0.15.Generate Huffman codes for the given source.
- Encode binary sequence 11010100 using unipolar RZ,unipolar NRZ, polar RZ,polar NRZ, AMI and differential Manchester line coding techniques.
- List importance of digital communication in the modern era.
- Prepare chart to add key details for each technique, such as advantages, disadvantages, and real-world applications.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Analog line coding and decoding trainer kit.	1
2	Cathode ray oscilloscope Dual Trace 20/30/100 Mhz,1 Mega ohm input impedance.	1,7,9,10,11,13,14,15,16,17,18,19,20,22,27,28
3	DSO with Bandwidth : 50-100 MHz TFT colour LCD Dual channel real time sampling1GSa/s equivalent sampling 25 GSa/s Memory 1Mbpts 10 waveforms and 10 Set upscan be stored.	1,7,9,10,11,13,14,15,16,17,18,19,20,22,27,28
4	Function generator : Frequency range 0.1 Hz to 30 Mhz.	1,7,9,10,11,13,14,15,16,17,18,19,20,22,27,28
5	Pulse code modulation and demodulation trainer kit.	11
6	Differential pulse code modulation and demodulation trainer kit.	12
7	Delta and Adaptive delta modulation and demodulation trainer kit.	13,14
8	ASK,FSK,PSK,QPSK and QAM trainer kit.	15,16,17,18,19
9	Time division multiplexing trainer kit.	20
10	Frequency division multiplexing trainer kit.	22
11	Simulation software suitable for communication experiments: MATLAB,SCILAB or any other relevant open source software.	4,3,8,12,21,23,24,27,28,2
12	Hamming code (7 bit) trainer kit.	5,6
13	Sampling (natural and flat top signal) and reconstruction trainer kit.	7
14	PPM, PWM trainer kit for signal generation and detection.	9,10

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

DIGITAL COMMUNICATION SYSTEMS **Course Code : 314326**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Digital Communication System and Coding Methods	CO1	16	4	6	8	18
2	II	Pulse Code Modulation Techniques	CO2	14	4	4	6	14
3	III	Digital Modulation Techniques	CO3	12	4	4	6	14
4	IV	Multiplexing and Multiple Access Technique	CO4	10	4	4	4	12
5	V	Spread Spectrum (SS) Modulation	CO5	8	4	4	4	12
Grand Total				**60**	**20**	**22**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit test of 30 marks and average of two-unit test will considered for out of 30 marks.

For formative assessment of laboratory learning 50 marks.Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.

End semester summative assessment of 25 marks for laboratory lerning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	3	3	2	1	1	1			
CO2	2	2	2	2	1	1	1			
CO3	2	2	2	2	1	1	1			
CO4	2	2	1	2	1	1	1			
CO5	2	2	1	2	1	1	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	K.Sam Shanmugam	Digital and Analog Communication Systems	Wiley India Pvt Ltd, ISBN-9788126509140
2	Rao. Ramkrishna P.	Digital communication	McGraw Hill Education (1 July 2017),ISBN-9780070707764
3	Simon Haykin	Digital Communications	John Wiley and Sons,ISBN-9788126508242
4	B. P. Lathi	Modern Digital and Communication Systems	Oxford university press,ISBN-9780198073802

DIGITAL COMMUNICATION SYSTEMS **Course Code : 314326**

Sr.No	Author	Title	Publisher with ISBN Number
5	Bernard Sklar	Digital Communications: Fundamentals and Applications	Pearson 2021,ISBN-9780134588568

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://nptel.ac.in/courses/117101051	Introduction to Digital Communication by NPTEL
2	https://www.etti.unibw.de/labalive/experiment/qpsksignalgeneration/	virtual communication lab for practicals
3	https://nptel.ac.in/courses/106105082	Data Communication
4	http://www.digimat.in/nptel/courses/video/117105136/L13.html	Spread spectrum techniques

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

CONSUMER ELECTRONIC SYSTEMS **Course Code : 314327**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Electronics & Computer Engg.**
Programme Code	**: DE/ EJ/ ET/ EX/ IE/ TE**
Semester	**: Fourth**
Course Title	**: CONSUMER ELECTRONIC SYSTEMS**
Course Code	**: 314327**

I. RATIONALE

The usage and demand for consumer electronic appliances is increasing in both domestic as well as industries. This increases the demand for trained man power in the relevant industries. This course will provide working principle of various consumer appliances/gadgets /equipments and skills to troubleshoot and maintain them in scientific way. The knowledge gained will help the students in the manufacturing units of these consumer gadgets or help the students to start their own enterprise.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain the following industry/employer expected outcome through various teaching learning experiences.
Maintain various consumer electronic appliances/equipments.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Maintain the given type of audio system.
- CO2 - Test different types of video systems.
- CO3 - Troubleshoot various consumer electronic appliances.
- CO4 - Use various smart appliances.
- CO5 - Maintain various office automation appliances.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314327	CONSUMER ELECTRONIC SYSTEMS	CEL	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.

6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Compare mono, stereophonic and quadraphonic amplifier. TLO 1.2 Explain the controls available on Hi-Fi Amplifier. TLO 1.3 Describe the operating principle and working of the given type of microphone. TLO 1.4 Explain with sketch the construction and working principle of the given type of speaker. TLO 1.5 Draw the block diagram of Public Address System with explanation.	**Unit - I Audio Fundamentals** 1.1 Basic characteristics of sound signal : Intensity and loudness, pitch, frequency response, fidelity, sensitivity and selectivity 1.2 Audio Amplifiers: Mono, stereo, quadraphonic, block diagram of Hi- Fi amplifier and its working, use of bass, treble tone controls 1.3 Microphone: Working principle and Types - condenser, crystal, electret, laser 1.4 Speakers: Working principle and types- electrostatic, dynamic, plasma arc, Bluetooth 1.5 Multi-speaker system: Definition, Crossover Networks, Impedance matching 1.6 Public Address System (PA system) and Home theatre : Block diagram and working principle	Lecture Using Chalk-Board Video Demonstrations Model Demonstration
2	TLO 2.1 Describe working of CCTV system with functional block diagram. TLO 2.2 Describe with block diagram the working of LCD TV. TLO 2.3 Explain the working of LED TV. TLO 2.4 Explain with sketch the functions of given blocks of DTH. TLO 2.5 Write features and applications of Smart interactive TV.	**Unit - II Video Systems** 2.1 Closed circuit television (CCTV): functional block diagram, working ,installation of CCTV 2.2 Liquid crystal display (LCD) television: Principle, Block diagram and working 2.3 Block diagram and working principle: Light emitting diode(LED) TV, Organic light emitting diode(OLED) TV, Quantum dot light emitting diode (QLED) television 2.4 Direct to Home (DTH) television : Block diagram and working principle 2.5 Smart interactive TV : Features and applications	Demonstration Lecture Using Chalk-Board
3	TLO 3.1 Explain with sketch the working of photocopier machine. TLO 3.2 Prepare specifications of a Microwave oven and describe its working. TLO 3.3 State function of each block of washing machine. TLO 3.4 Describe features of camcorder. TLO 3.5 Explain the working of scanner. TLO 3.6 Describe the working of bar code reader.	**Unit - III Consumer Electronic Appliances** 3.1 Photocopier: Block diagram and working principle 3.2 Microwave Oven: Block diagram, single chip controllers, types, wiring diagram, safety instructions, electrical specifications 3.3 Washing Machine: Block diagram, electrical specifications, types and features of (Automatic, Semi-automatic and Fuzzy Logic) washing machine 3.4 Digital Camera and Camcorder: Working principle, picture processing, picture storage, electrical specification 3.5 Scanner: Working principle, Specifications, types of scanners (Handheld ,Flatbed, Sheet fed ,Portable Scanners), interface cables, ports and connectors 3.6 Bar code reader: Working principle , applications	Lecture Using Chalk-Board Demonstration Site/Industry Visit
4	TLO 4.1 Explain constructional features with	**Unit - IV Smart appliances.** 4.1 Wearable antenna: Construction, Working principle	Lecture Using Chalk-Board

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	applications of wearable antennas. TLO 4.2 Describe with functional block diagram working of smart wristband. TLO 4.3 Describe with functional block diagram working of VR headset. TLO 4.4 List the augmented reality devices used in classroom. TLO 4.5 State regulations related to recycling of E-waste.	and applications 4.2 Smart Wrist bands :Construction, applications and functional units (sensors ,signal conditioning, microcontrollers, wireless connectivity , power management, firmware, storage) 4.3 Virtual Reality (VR) Headset: Functional block diagram and functional units (tracking unit, processing unit, display unit, sensors, pixel resolution, field of view),virtual reality supported platforms such as Windows Mixed Reality(WMR) 4.4 Augmented Reality(AR) devices: Functional block diagram, working principle, examples 4.5 Recycling of electronic appliances :Regulations and procedures	Video Demonstrations Flipped Classroom
5	TLO 5.1 Describe the working of a laser printer. TLO 5.2 Explain the function of various controls of LED projector. TLO 5.3 State the features of smart interactive board. TLO 5.4 Describe the working of given component in biometric attendance system. TLO 5.5 Explain functional blocks of video conferencing system with suitable sketch. TLO 5.6 Describe the working of paper shredding machine.	**Unit - V Office Automation appliances** 5.1 Laser Printer: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure 5.2 Smart Interactive Board: Working procedure, features and specifications 5.3 LED Projector: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure 5.4 Biometric Attendance system: Hardware and software components , working procedure 5.5 Video conferencing system: Components and working procedure 5.6 Paper shredding machine : Components and working procedure	Lecture Using Chalk-Board Presentations Model Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Test and measure the various parameters of a microphone.	1	Performance of given type of microphone	2	CO1
LLO 2.1 Test the given speaker and plot its frequency response.	2	*Performance of given speaker	2	CO1
LLO 3.1 Measure voltages at different sections of Hi-Fi amplifier.	3	*Performance of given Hi-Fi amplifier	2	CO1
LLO 4.1 Locate any three different faults by voltage analysis method in a Hi-Fi Audio amplifier.	4	*Fault identification in Hi-Fi amplifier	2	CO1
LLO 5.1 Measure the voltages for various components of CCTV unit.	5	*Test the CCTV unit	2	CO2
LLO 6.1 Connect CCTV Cameras to DVR/IVR, record and replay.	6	Connection of CCTV cameras to DVR/IVR	2	CO2
LLO 7.1 Measure voltage of Power supply , Audio section and Video section of LCD TV. LLO 7.2 Compare the above measured voltage with standard voltage.	7	Voltage analysis of power supply section,audio section and video section of LCD TV	2	CO2

CONSUMER ELECTRONIC SYSTEMS **Course Code : 314327**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 8.1 Troubleshoot the faults in a LCD TV- a) No picture, No Audio b) No Audio but proper picture. c) Complete dead TV.	8	Fault analysis of LCD TV	2	CO2
LLO 9.1 Test the performance of various sections of given LED TV - a) Power supply b) Driver LED section c) Audio section d) Video section.	9	*Voltage analysis of given sections of LED TV	2	CO2
LLO 10.1 Locate and rectify faults in a LED TV - a) No picture, No Audio b) No Audio but proper picture.c) Complete dead TV .	10	*Fault analysis in LED TV	2	CO2
LLO 11.1 Test the components and operation of the paper feed mechanism in a photocopier machine through dismantling and reassembly.	11	*Dismantling and assembling of paper feed mechanism in photocopier machine	2	CO3
LLO 12.1 Identify and test various front panel controls of microwave oven.	12	*Identification of front panel controls of microwave oven	2	CO3
LLO 13.1 Detect and rectify faults in microwave oven - a) Oven not starting b) Oven not heating c) Error display.	13	*Fault analysis in microwave oven	2	CO3
LLO 14.1 Set the time duration of different wash cycles for a given washing machine.	14	*Performance of washing Machine	2	CO3
LLO 15.1 Sketch the wiring diagram of washing machine and locate its main components.	15	Sketch the wiring diagram of washing machine	2	CO3
LLO 16.1 Troubleshooting of washing machine - a) Excessive noise during operation b) Door lock problem. .	16	Fault analysis of washing machine	2	CO3
LLO 17.1 Test the various functions of Camcorder such as iris and shutter speed control, computer interface, recording rate and recording format.	17	Use the various functions of Camcorder	2	CO3
LLO 18.1 Interface the scanner to the desktop computer and test its various controls.	18	*Interfacing of scanner	2	CO3
LLO 19.1 Measure the signal strength of wearable antenna.	19	Performance of given wearable antenna	2	CO4
LLO 20.1 Display faults in smart wrist bands - a) display not working b) poor brightness .	20	*Display faults in smart wrist bands	2	CO4
LLO 21.1 Take Back-up of data from wearable device such as wrist band to given drive/ storage device.	21	Data back-up from wearable device	2	CO4
LLO 22.1 Test the VR headset problems - a) Bluetooth connectivity b) USB port connection .	22	Connection problems in VR headset	2	CO4
LLO 23.1 Use the controllers of VR headset to navigate within the virtual environment.	23	Performance of VR headset	2	CO4
LLO 24.1 Interface the laser printer to the desktop computer and identify various controls.	24	*Interfacing of laser printer	2	CO5
LLO 25.1 Detect and remove the faults in laser printer - a) The print quality is not very good. b) White Lines and Streaks. c) Cartridge leakage .	25	* Fault analysis for the cartridge related problems of laser printer	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 26.1 Measure the speed of given laser printer.	26	*Performance of laser printer	2	CO5
LLO 27.1 Interface and configure LED projector using various controls.	27	Interfacing of LED projector	2	CO5
LLO 28.1 Create new interactive whiteboard pages using Interactive whiteboard simulation software like Mimio Studio, SMART Learning Suite Online.	28	*Creating new interactive whiteboard pages	2	CO5
LLO 29.1 Test the audio and video settings for a video conferencing session.	29	Assess the quality of a video conferencing session	2	CO5
LLO 30.1 Determine the shredding capacity (number of sheets) and speed (sheets per minute) of a paper shredding machine.	30	Determination of capacity and speed of a shredding machine	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare a report on consumer product international standards.
- Do market survey of various models of Camcorder on the basis of different features through online/offline and make a report.
- Make presentation on functioning of biometric attendance system in institute.
- Develop a PA system for institute conference hall.
- Install and prepare annual maintenance report of SMPS/CCTV available in the institute.

Visit

- Visit to consumer product manufacturing unit.
- Visit to nearby electrical and hardware repair center of consumer appliances and make a report.

Assignment

- Prepare chart on CCTV components and specifications.
- Draw neat sketches of condenser and electret microphones.
- Draw neat sketches of electrostatic and dynamic speakers
- Compare washing machine types, features and electrical specifications

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials

and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Digital Multimeter: 31/2 digit display,9999 counts digital multimeter measures: Vac,Vdc(1000Vmax) Adc, Aac (10 amp max.) Resistance (0-100 M ohm), capacitance and temperature measurements .	1,2,3,4,7,5,8,9,10,12,13,20,22
2	Microwave oven – Supply voltage: 220 volts, 50Hz. single phase A.C. supply, Power Consumption: 1300W approx., Microwave Power: 700W - 850W,Oven Capacity: 20 litres - 25 litres ,Microwave Frequency: 2450 MHz, Control : Soft/one touch control, Timer : 60 minutes - 90 minutes. (any other equivalent) .	12,13
3	Cabinet/panel opener tool set / Telecommunication tool set, screwdriver dissemble tool, crowbar set, Hammer, Pliers, Wire cutter, LAN Crimping Tool, Aligner.	12,13,14,15,16,18,20,21,25
4	Washing machine unit (suitable unit) - 240 V ,50 Hz, Fully automatic control, Max. Spin Speed 780 RPM. (any other equivalent)	14,15,16
5	Camcorder - 4K HDR Video Recording.	17
6	Scanner-type-Flatbed color, Photoelectric device-Color CCD line sensor, effective pixels- 40,800 × 56,160 pixels at 4800 dpi,Scanning resolution-4800 dpi (main scan),9600 dpi with Micro Step (sub scan),Output resolution-50 to 6400, 9600, and 12800 dpi, Image data-16 bits per pixel per color internal,16 bits per pixel per color external (maximum),Interface-One USB port. (any other equivalent) .	18
7	Smart wristband , bluetooth synchronization, low power accelerometer sensor, vibration motor support, operating temp -10°C to 50° C ,system requirement –iOS 9.0 and above/Android 5.0 and above. (any other equivalent)	19,20,21
8	Audio level/dB meter - Functions : MAX / MIN / HOLD, Auto Power Off ,Range : 35 dB ~ 130 dB (31.5 Hz ~ 8 kHz),Accuracy : ±1.5 dB (under reference condition), Resolution : 0.1 dB,Power : 9 V Battery.	2,19
9	VR headset- Max Resolution 3664×1920 per eye, Screen Type Fast Twitch LCD, Max Refresh Rate-120Hz, Tracking 6DOF Inside Out Tracking (wireless). (any other equivalent) .	22,23
10	Laser Printer -600 x 600 dpi ,Input capacity-Up to 150 sheets, Output capacity-Up to 100sheets,Media type Paper (laser, plain, photo), Memory - standard 2 MB.(any other equivalent).	24,25,26
11	LED Projector- Built in 10 W speakers, 28dB low noise bright 4000 lumens, versatile connectivity, USB power, long lamp life upto to 15000 hours. (any other equivalent) .	27
12	Simulation Software : mimio studio/SMART Learning Suite Online .	28
13	Desktop PC or laptop with video conferencing platform such as Zoom, Microsoft Teams, Cisco Webex, or Google Meet, cameras, microphones, and speakers compatible with chosen video conferencing platform, stable and high-speed internet connection .	29
14	Hi Fi amplifier system trainer - Hi-Fi Audio Amplifier (Using Power Transistor)Trainer Kit- For Measure Power Transistor Voltages OfDifferent Stages. Demonstration model of Hi Fi amplifier with various test points for wave form tracing, 2 Channel, tone controls bass, treble, blend, master gain control,5+5 band graphic equalizer with fault creation facility.	3,4
15	Automatic/Semi automatic cross-cut shredder/shredding machine with shred Speed- 1.5 m/min and shred capacity of 20 sheets or any suitable configuration .	30

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
16	CCTV tool monitor- Build in battery: 3.7 volt 3000 mAH, Power Output: 12V DC, Resolution: 480x234, Screen Size: 3.5 Inch.	6,5
17	CAT 5/CAT 6 cable tester.	6,5
18	LCD TV trainer Kit -14" (or other equivalent) with Faults creating switches and test points at various sections.	7,8
19	Cathode Ray Oscillator: DC -30 Mhz dual channel, Rise time:12 ns approx. accuracy :±3 % input impedance:1 M ohm.	7,8,9,10
20	LED Color TV trainer Kit -18 "/21" (or other equivalent) with Faults creating switches and test points at various sections.	9,10

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Audio Fundamentals	CO1	6	2	2	4	8
2	II	Video Systems	CO2	7	4	4	4	12
3	III	Consumer Electronic Appliances	CO3	10	4	6	6	16
4	IV	Smart appliances.	CO4	10	4	6	6	16
5	V	Office Automation appliances	CO5	12	4	6	8	18
Grand Total				**45**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two-unit test marks will be considered for out of 30 marks.

For formative assessment of laboratory learning 25 marks.
Each practical will be assessed considering 60 % weightage to process, 40 % weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.

End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	1	3	1	1	3			
CO2	2	1	2	3	1	1	3			
CO3	3	1	2	3	1	1	3			
CO4	2	1	2	3	3	1	3			
CO5	2	1	2	3	1	1	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bali S.P.	Consumer Electronics	Pearson Education India, New Delhi,2007;ISBN:9788131717592
2	Bali R and Bali S.P.	Audio video systems: principle practices and troubleshooting	Khanna Book Publishing Co.(P) Ltd.,New Delhi,2014;ISBN:9780070067172
3	Gupta R.G.	Audio Video Systems: principle and practices and troubleshooting	Mc Graw Hill, New Delhi , 2010; ISBN:9780070699762
4	Whitaker Jerry and Benson Blair	Standard handbook of Audio engineering	McGraw-Hill Education; New Delhi 2010; ISBN -13:9780070067172
5	Glen Ballou	Handbook for Sound Engineering	ELSEVIER-British Library Cataloguing-in-Publication Data,2008; ISBN: 9780240809694
6	Whitaker Jerry and Benson Blair	Mastering Digital Television	McGraw-Hill Professional, New Delhi, 2010; ISBN-13:9780071411806
7	Haider Raad	The Wearable Technology handbook .	Ohio publishing and academic services, Metaverse Edition,2022: ISBN: 9781737233480
8	Murray Ramirez	Virtual Reality for Beginners! How to Understand, Use and Create with VR	Create Space Independent Publishing Platform,2016; ISBN-13 : 9781540532220
9	P Kaliraj, Devi Thirupathi	Innovating with Augmented Reality: Applications in Education and Industry	CRC Press, Taylor and Francis group,ISBN: 9781003175896
10	Jerry D. Gibson.	Multimedia Communications	ISBN:9780122821608

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://ed.iitm.ac.in/~raman/agcl/VR_Paper.pdf	VR Headset
2	https://www.nxp.com/assets/block-diagram/en/AugmentedReality andVirtualRealityHeadsets.pdf	V R Headset
3	https://www.nxp.com/assets/block-diagram/en/SmartWatch_SMART WATCH.pdf	Smart Watch
4	https://www.nxp.com/assets/block-diagram/en/SmartWatch_SMART WATCH.pdf	Smart Watch
5	https://www.nsdcindia.org/scmp/assets/image/1179656187-CCTV_ Installation_Technician__English.pdf	CCTV installation handbook
6	https://toshiba.semicon-storage.com/ap-en/semiconductor/appl ication/multi-function-printer.html	Multifunctional printer/ All-in-one printer
7	http://digimat.in/nptel/courses/video/117105133/L10.html	Perception of sound
8	https://www.coursera.org/learn/introduction-virtual-reality	Introduction to VR
9	https://www.youtube.com/watch?v=d1Lk7EL-XEo	LCD/OLED
10	https://www.youtube.com/watch?app=desktop&v=6-heUDnJaHQ	Simulation for wearable antenna
11	https://www.youtube.com/watch?v=S5n3APXOk_k	Wearable antenna
12	https://www.instructables.com/DIY-LED-Projector/	LED Projector
13	https://da-iitb.vlabs.ac.in/exp/washin-machine-control/simul ation.html	Washing machine simulation
14	https://ijrpr.com/uploads/V4ISSUE3/IJRPR10799.pdf	Paper shredder machine
15	https://core.ac.uk/download/pdf/12008168.pdf	Biometric attendance system.

CONSUMER ELECTRONIC SYSTEMS **Course Code : 314327**

Sr.No	Link / Portal	Description
16	https://www.indiafilings.com/learn/e-waste-management/	Recycling of electronic appliances
17	https://cpcb.nic.in/displaypdf.php?id=aHdtZC9HVUlERUxJTkVTX0VXQVNURV9SVUxFU18yMDE2LnBkZg==	e waste management
18	http://slot-tech.com/interestingstuff/a%20collection%20of%20technical%20stuff%20from%20a%20technician%20in%20Libya/Printer%20and%20Photocopier%20Troubleshooting%20and%20Repair%20Collectio.pdf	Printer and Photocopier Troubleshooting and Repair
19	https://www.fau.edu/ehs/info/microwave-fire-safety.pdf	Microwave oven safety instructions.

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MICROCONTROLLER & APPLICATIONS **Course Code : 314328**

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Electronics & Computer Engg.**
Programme Code	**: AO/ DE/ EJ/ EK/ ET/ EX/ IC/ IE/ IS/ TE**
Semester	**: Fourth**
Course Title	**: MICROCONTROLLER & APPLICATIONS**
Course Code	**: 314328**

I. RATIONALE

Microcontrollers plays a very important role in the design, development of embedded systems. Automation is used in every field of engineering and microcontroller is inbuilt component of these systems. Diploma engineers have to deal with various microcontroller based systems and maintain them. This course will enable the students to develop the skills to use and maintain microcontroller based applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:

• Maintain microcontroller based systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret architecture of 8-bit microcontrollers.
- CO2 - Develop program in 8051 in assembly language for the given operation.
- CO3 - Develop program using timers and interrupts.
- CO4 - Interface the memory and I/O peripherals to 8051 microcontroller.
- CO5 - Maintain microcontroller based applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/ s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./ Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314328	MICROCONTROLLER & APPLICATIONS	MAA	DSE	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.

6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 List the features of 8051 Microcontroller. TLO 1.2 Explain the significance of selection factors while selecting Microcontroller for application. TLO 1.3 Describe the 8051 block diagram. TLO 1.4 Differentiate Microcontroller and Microprocessor for the given parameters. TLO 1.5 Compare Harvard architecture and Von-Neumann architecture. TLO 1.6 Explain functions of each block of 8051 Microcontroller. TLO 1.7 Compare the given derivatives of 8051 Microcontroller.	**Unit - I Microcontroller Overview and 8051 Architecture** 1.1 Features and selection factors for Microcontroller 1.2 Block diagram of 8051 Microcontroller: CPU, input device, output device, memory and buses 1.3 Comparison of Microcontroller and Microprocessor on basis of: Memory, Complexity, Type of Architecture, Cost, Applications, Typical examples of Microcontrollers and Microprocessors 1.4 Architectures of Microcontroller: Harvard , Von Neumann. Concept of pipelining 1.5 8051 Microcontroller: Architecture, Pin Configuration, Memory Organisation, Power saving options 1.6 Derivatives of 8051 (8951, 8031, 8751). Comparison between derivatives	Learning using Chalk-Board Blended Classroom Presentations
2	TLO 2.1 Explain the function of the given software development tools. TLO 2.2 Classify addressing modes of 8051 with examples. TLO 2.3 Describe the function of the given instruction with suitable example. TLO 2.4 Explain the use of the given assembler directives with examples. TLO 2.5 Develop simple programs to perform the following operations: Data manipulation, Masking, Stack operation, Branching execution.	**Unit - II 8051 Programming** 2.1 Software Development Cycle: Editor, Assembler, Compiler, Cross-Compiler, Linker, Locator 2.2 Addressing Modes : Immediate, Register, Direct, Indirect, Indexed 2.3 Instruction set :Data Transfer, Arithmetic, Logical, Branching, Machine control and Boolean 2.4 Assembler Directives: ORG, DB, EQU, END, CODE, DATA 2.5 Assembly Language Programming (ALP): Data manipulation, Masking , Stack operation, Branch related programming	Lecture using Chalk-Board Presentations Blended Learning
3	TLO 3.1 Describe the functions of Timer/ Counters, their applications, and modes of Timers. TLO 3.2 Generate the waveforms by using the given mode of Timer. TLO 3.3 Explain the interrupt mechanism with the help of suitable example. TLO 3.4 Explain the operation of given mode for Serial communication. TLO 3.5 Explain I/O Port Programming.	**Unit - III 8051 Timers, Interrupts, Serial and Parallel Communication** 3.1 Configuration and Programming of Timer/ Counter using Special Function Registers [SFRs]: TMOD, TCON, THx, TLx, Simple programs to generate the time delays 3.2 Configuration and Programming of interrupts using SFRs: IE, IP 3.3 Serial Communication SFRs: SCON, SBUF, PCON, Modes of serial communication, Simple Programs on serial communication. Serial Communication using MAX 232 3.4 Configuration and Programming of I/O Port : P0, P1, P2, P3	Lecture using Chalk-Board Hands-on Blended Learning
4	TLO 4.1 Interface Input/Output Devices with 8051 microcontroller. TLO 4.2 Interface ADC with 8051	**Unit - IV 8051 Interfacing** 4.1 I/O Interfacing: Keyboard, Relays, LED, LCD, Seven Segment display	Lecture using Chalk-Board Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	microcontroller. TLO 4.3 Interface DAC with 8051 microcontroller. TLO 4.4 Describe with neat sketch the interfacing of the given external memory. TLO 4.5 Describe the procedure to troubleshoot the given I/O device.	4.2 Interfacing ADC 0808/09 with 8051. Simple programs for ADC interfacing 4.3 Interfacing DAC 0808/09 with 8051. Simple programs for DAC interfacing 4.4 Memory Interfacing: Program and Data Memory	Blended Learning Presentations
5	TLO 5.1 Generate the given waveform using 8051 and DAC. TLO 5.2 Interface Analog Input devices with 8051 microcontroller. TLO 5.3 Program 8051 for the given application. TLO 5.4 Interface Stepper motor to 8051. TLO 5.5 Describe the procedure to troubleshoot the given microcontroller based application.	**Unit - V 8051 Applications** 5.1 Square and Triangular waveform generation using DAC 5.2 Temperature sensor (LM35) interfacing using ADC to 8051 5.3 Water Level controller design using 8051 5.4 Stepper Motor Interfacing to 8051 to rotate in clockwise and anticlockwise direction	Lecture using Chalk-Board Hands-on Blended Learning Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify the functions of various blocks of 8051 microcontroller development board.	1	* Identification of various blocks of 8051 microcontroller development board	2	CO1
LLO 2.1 Develop an Assembly Language Program (ALP) for addition of two numbers using various addressing modes and assembler directives.	2	Assembly Language Program using various addressing modes	2	CO2
LLO 3.1 Develop an ALP to perform arithmetic operations: addition, subtraction, multiplication and division on 8-bit data.	3	* ALP to perform arithmetic operations on 8-bit data	2	CO2
LLO 4.1 Develop an ALP to perform arithmetic operations: addition, subtraction on 16-bit data.	4	* ALP to perform arithmetic operations on 16- bit data	2	CO2
LLO 5.1 Develop an ALP to perform addition of BCD data stored at external memory and store result in internal memory.	5	* ALP to perform addition of BCD data	2	CO2
LLO 6.1 Develop an ALP for sum of series of numbers stored in RAM locations 40-49H. Find the sum of the values at the end of the program, store the lower byte in 30H and the higher byte in 31H.	6	* ALP for series addition	2	CO2
LLO 7.1 Develop an ALP to transfer data from source to destination locations of internal/ external data memory.	7	* Array data transfer from source locations to destination locations	2	CO2
LLO 8.1 Develop an ALP to exchange block of data from source to destination location of internal/ external data memory.	8	* Block exchange of data from source locations to destination location	2	CO2
LLO 9.1 Develop an ALP for identifying smallest number from the given data bytes stored in internal/ external data memory.	9	* Finding the smallest number from the given data bytes	2	CO2
LLO 10.1 Develop an ALP for identifying largest number from the given data bytes stored in internal/ external data memory.	10	Finding the largest number from the given data bytes	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Develop an ALP for arranging numbers in ascending order stored in internal/ external data memory.	11	* Arranging the numbers in ascending order	2	CO2
LLO 12.1 Develop an ALP for arranging numbers in descending order stored in internal/ external data memory.	12	Arranging numbers in descending order	2	CO2
LLO 13.1 Write an ALP to generate delay using timer register.	13	* Generate delay using timer register	2	CO3
LLO 14.1 Develop an ALP to transfer 8 bit data serially on serial port.	14	* Serial 8 bit data transfer on serial port	2	CO3
LLO 15.1 Interface LED with microcontroller and turn it 'ON' with microcontroller interrupt.	15	LED interfacing to 8051	2	CO4
LLO 16.1 Develop an ALP to generate pulse and square wave by using timer delay.	16	Generating Pulse and Square wave using timer delay	2	CO4
LLO 17.1 Interface 4 X 4 LED matrix with 8051 to display various pattern.	17	LED matrix Interfacing to 8051	2	CO4
LLO 18.1 Interface 7-segment display to display the decimal number from 0 to 9.	18	* Seven Segment Display interface for displaying decimal numbers	2	CO4
LLO 19.1 Interface relay with microcontroller and turn it 'ON' and 'OFF'.	19	* Relay interfacing to Microcontroller	2	CO4
LLO 20.1 Interface LCD with 8051 microcontroller to display the characters and decimal numbers.	20	* LCD interfacing to 8051 to display characters and decimal numbers	2	CO4
LLO 21.1 Interface the given keyboard with 8051 and display the key pressed.	21	Keyboard interfacing to 8051	2	CO4
LLO 22.1 Interface ADC with 8051 microcontroller and verify input/output.	22	* ADC interfacing to 8051	2	CO4
LLO 23.1 Interface DAC with 8051 microcontroller to generate square wave.	23	* DAC Interfacing to generate the square waveform	2	CO5
LLO 24.1 Interface DAC with 8051 microcontroller to generate triangular wave, saw-tooth wave.	24	DAC interfacing to generate the triangular waveforms	2	CO5
LLO 25.1 Interface stepper motor to microcontroller and rotate in clockwise direction at the given angles.	25	* Stepper Motor interfacing to 8051	2	CO5
LLO 26.1 Interface stepper motor to microcontroller and rotate in anti-clockwise direction at the given angles.	26	Stepper Motor interfacing to 8051 for rotating anti-clockwise	2	CO5
LLO 27.1 Design water level controller using any suitable open source simulation software to detect and control the water level in a tank.	27	Water Level Controller using 8051	4	CO5
LLO 28.1 Interface temperature sensor LM35 to 8051 to read temperature, convert it to decimal and send the value to Port 0 with some delay.	28	Temperature Sensor interfacing to detect and measure temperature	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Build a class period bell using microcontroller 8051.
- Build a circuit using 8051 microcontroller to blink LED.
- Build a circuit to display number 0 to 9 with a given delay.
- Build digital clock with 8051 microcontroller.
- Develop Fire Detection System using smoke and temperature sensor.

Student Activity

- Prepare power point presentation on applications of microcontroller.
- Undertake a market survey of different microcontrollers.

Assignment

- Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
- Prepare chart of stepper motor to display its features and steps for its operations using data sheets.
- Prepare a chart of various types of ADC and DAC to display its features and pin functions using data sheets.
- Prepare a chart of various types of LCDs to display its features , pin functions and steps of operations using data sheets.
- Prepare a power point presentation on 8051 interfacing/applications.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	DSO with Bandwidth : 50-100 MHz TFT colour LCD Dual channel real time sampling1GSa/s equivalent sampling 25 GSa/s Memory 1Mbpts 10 waveforms and 10 Set up scan be stored.	13,16,23,24
2	4X4 LED matrix suitable to interface with 8051 trainer kit	17
3	7-segment LED Display	18
4	Relay trainer board suitable to interface with 8051 trainer kit	19
5	LCD trainer board	20
6	Keyboard: 4 x 4 trainer board	21
7	ADC(0808) trainer board	22
8	DAC (0808) trainer board	23,24
9	Stepper Motor: 50/100 rpm	25,26
10	Water level controller kit	27
11	Temperature Controller trainer board	28
12	Temperature Sensor LM35: 5V operating voltage, Operating temperature range (°C) -55 to 150, analog output	28
13	8051 Microcontroller kit: On-chip 64 KB ISP+IAP flash, 1KB SRAM, 5V operating voltage, 0 to 40 MHz 64 kB of on-chip Flash program memory	All
14	Desktop PC with microcontroller simulation software.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Microcontroller Overview and 8051 Architecture	CO1	11	2	6	6	14
2	II	8051 Programming	CO2	8	4	4	4	12
3	III	8051 Timers, Interrupts, Serial and Parallel Communication	CO3	10	4	4	6	14
4	IV	8051 Interfacing	CO4	10	4	6	8	18
5	V	8051 Applications	CO5	6	2	4	6	12
Grand Total				**45**	**16**	**24**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks.
- End semester summative assessment is of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	1	1	1	-	1			
CO2	2	2	2	2	1	-	2			
CO3	2	2	2	1	1	1	2			
CO4	2	2	2	2	1	-	2			
CO5	2	3	2	2	1	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Mazidi Muhammad Ali, Mazidi Janice Gillispe, Mckinlay Rolin D	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Pearson Publication, 2017 ISBN: 9788131710265

Sr.No	Author	Title	Publisher with ISBN Number
2	Ayala Kenneth J	The 8051 Microcontroller	Thomson Delmar Learning, 2004 ISBN: 9781401861582
3	Deshmukh Ajay V	Microcontroller: Theory and Application	McGraw Hill,2011 ISBN: 9780070585959
4	Pal Ajit	Microcontrollers: Principle and Application	PHI Learning, 2014 ISBN: 978812034394
5	Chattopadhyay Santanu	Microcontroller and Applications	All India Council for Technical Education, 2023 ISBN: 9788196057602

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://vlabs.iitkgp.ac.in/rtes/#	Keyboard-MCU interfacing take a input from keypad and display on LCD
2	https:// studytronics.weebly.com/8051microcontroller.html	8051 Microcontroller Architecture, Internal Memory , Instruction Set, Timers and Counters, Interrupts
3	https://archive.nptel.ac.in/courses/108/105/108105102/	S. Chattopadhyay, SWAYAM/NPTEL course on “Microprocessors and Microcontrollers”
4	https://www.keil.com/download/product/	Introduction to KEIL tool for 8051 programming
5	https://www.dnatechindia.com/Interfacing-LCD-to-8051.html	Interfacing LCD to 8051
6	https://web.mit.edu/6.115/www/document/8051.pdf	MCS@51 Microcontroller family user’s manual
7	https://econtent.msbte.edu.in/econtent/ marathi_econtent.php	Microcontroller and Applications Learning Material In Marathi-English

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

BASIC POWER ELECTRONICS **Course Code : 314363**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/**
Programme Code	**: DE/ EJ/ EK/ ET/ EX/ IC/ IE/ IS**
Semester	**: Fourth**
Course Title	**: BASIC POWER ELECTRONICS**
Course Code	**: 314363**

I. RATIONALE

Power electronics plays a important role in the efficient use of electrical energy and environmental control. The power electronic circuits are used in industrial automation and in manufacturing sector of control circuits. This course is developed to empower the students to apply their knowledge to solve broad power electronics based industrial application problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:

• Maintain electronic control systems comprising of power electronic components.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify power semiconductor devices used in Power Electronics circuit.
- CO2 - Maintain SCR Triggrering and Commutating Circuits.
- CO3 - Use phase controlled rectifiers in different applications.
- CO4 - Analyze power converter circuits.
- CO5 - Maintain power electronic circuits used in various domestic and industrial applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./ Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314363	BASIC POWER ELECTRONICS	BPE	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.

6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Classify Thyristor family devices on the basis of applications and features. TLO 1.2 Explain the working of various power electronics devices with sketches. TLO 1.3 Interpret V-I characteristic of the given power electronic device. TLO 1.4 Calculate latching and holding current for given thyristor. TLO 1.5 Select proper triggering device for the given circuit and justify it. TLO 1.6 Identify various power electronic devices along with their specification for given application.	**Unit - I Power Semiconductor Devices** 1.1 Classification of Thyristor family devices 1.2 Construction ,working principle, V-I characteristics and applications of Power diode ,Power MOSFET and IGBT, Reverse recovery characteristics of power diode 1.3 SCR- Construction ,working principle, V-I characteristics and applications, Two transistor analogy, latching and holding current for SCR 1.4 LASCR, TRIAC, GTO,SCS - Construction ,working principle, V-I characteristics and applications 1.5 Triggering devices :UJT, PUT, SUS, SBS, DIAC -Construction, working principle, V-I characteristics and applications	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Describe the turn- ON mechanism of given SCR circuit. TLO 2.2 Explain with sketches the effect of the given firing angles on load voltages. TLO 2.3 Explain with sketches the triggering methods for the given SCR. TLO 2.4 Differentiate various types of commutation methods for SCR with sketches. TLO 2.5 Justify the need of protection circuit for SCR. TLO 2.6 Explain with sketches the working of protection circuits for the given SCR against over voltage and over current.	**Unit - II Triggering and Commutation methods of SCR** 2.1 Concept of turn ON mechanism for given SCR: High voltage, thermal triggering, dv/dt triggering, gate triggering 2.2 Gate trigger circuits: Types of gate signals: DC signal, AC signal and pulse signal 2.3 Thyristor Triggering Circuits: Resistance Triggering Circuit, Resistor-Capacitor (RC) Triggering Circuit, half wave and full wave triggering Circuit, UJT (Unijunction Transistor) Triggering Circuit, Pulse Transformer Triggering Circuit, UJT/ PUT-relaxation oscillator circuit 2.4 Turn OFF (commutation) methods: Natural and Forced Commutation, Types: Class A, Class B, Class C, Class D, Class E, Class F 2.5 SCR protection circuits: Need, Factors causing permanent damage to SCR, causes of over voltage and over current, Over voltage protection circuits using RC snubber circuit and non linear resistor, over current protection circuit using Fuse operation, Electronic crowbar protection circuit	Presentations Lecture Using Chalk-Board
3	TLO 3.1 Explain with sketches the effect of change in firing angle on output voltage of the given rectifier considering concept of phase control. TLO 3.2 Explain operation of Half wave and Full wave	**Unit - III Phase controlled rectifiers** 3.1 Phase control parameters: Firing angle , and conduction angle 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, numerical	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	controlled rectifiers for given load. TLO 3.3 Explain operation of Semi-converters for given load. TLO 3.4 Calculate load voltage and load current of the given controlled rectifier. TLO 3.5 Describe working principle of multiphase rectifiers with circuit digram.	3.3 Single phase centre tapped full wave controlled rectifier and Bridge rectifier: circuit diagram, working and waveforms with R and RL load, effect of freewheeling diode with RL load, numerical 3.4 Semi- converters: circuit diagram, working and waveforms with R and RL load, effect of freewheeling diode with RL load 3.5 Three phase rectifier: need, circuit diagram, working and waveforms with R load	
4	TLO 4.1 Explain types of converters and classify. TLO 4.2 Explain the working of the given Choppers with sketches . TLO 4.3 Explain with sketches the working of the given type of inverter circuit. TLO 4.4 Describe performance parameters for inverters. TLO 4.5 Explain with sketches the working of the given type of Cycloconverter.	**Unit - IV Power Converters** 4.1 Chopper: Introduction, classification 4.2 Block diagram and working of step down chopper using IGBT, with R and RL load 4.3 Step up chopper using IGBT with R load 4.4 Inverter: Introduction, classification, Block diagram and working of Series inverter, Parallel inverter, Single phase Half bridge and Full bridge inverter 4.5 Performance parameters for the inverter: Harmonic factor of nth Harmonic, Total Harmonic Distortion, Distortion Factor, Lowest order Harmonic 4.6 Cyclo-converter: Introduction, Classification, Single phase Cyclo-converter: working principle of Midpoint configuration with R load	Lecture Using Chalk-Board Presentations Flipped Classroom
5	TLO 5.1 Describe the use of power electronic device in the given industrial circuit. TLO 5.2 Describe the performance of the given Industrial control circuit. TLO 5.3 Explain with sketches the working of the given type of UPS. TLO 5.4 Explain with sketches the working of the given type of SMPS.	**Unit - V Industrial applications of power electronic devices** 5.1 Proximity detector and Time delay circuit using SCR and PUT/UJT 5.2 Battery charger, Emergency light system and Flasher circuit using SCR 5.3 Static AC and DC circuit breaker and Zero Voltage Switch 5.4 Application of Choppers in Electric vehicles 5.5 Block diagram and concept of Online and Offline UPS 5.6 SMPS: concept, Block diagram and applications	Lecture Using Chalk-Board Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Test the SCR in forward conduction state and measure holding current (IH) and latching current (IL).	1	*Performance of SCR using IC 2N4103 or any other equvalent IC	2	CO1
LLO 2.1 Test the forward and transfer characteristics of given IGBT.	2	*Performance of IGBT using IC BUP 402 or any other equivalent IC	2	CO1
LLO 3.1 Test the performance of DIAC and plot its V-I characterstics.	3	*Performance of DIAC using IC DB3/ DB4 or any other equivalent IC through its V-I curve	2	CO1
LLO 4.1 Test the R and RC triggering circuits of SCR.	4	Masurement of output voltage by changing firing angle through variation in resistor, capacitor in R and RC triggering	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
		circuits of SCR.		
LLO 5.1 Measure output voltage by changing firing angle in synchronized UJT triggering circuit.	5	*Synchronized UJT triggering circuit.	2	CO2
LLO 6.1 Observe and verify Input-Output waveforms of Class C-Complimentary type commutation circuit.	6	*Class C-Complimentary type commutation circuit	2	CO2
LLO 7.1 Observe and verify Input-Output waveforms of half wave controlled rectifier with R, RL load and measure load voltage.	7	* Half wave controlled rectifier	2	CO3
LLO 8.1 Observe and verify the Input-output waveforms of full wave controlled rectifier with R, RL load and measure load voltage.	8	Performance of full wave controlled rectifier with R, RL load and measure load voltage.	2	CO3
LLO 9.1 Calculate firing angle and observe input-output voltage waveforms of 3- phase half wave controlled rectifier using Delta-star transformer.	9	Performance of 3- phase half wave controlled rectifier	2	CO3
LLO 10.1 Measure output voltage of step-up chopper for different values of duty cycles.	10	Performance of step-up chopper for different values of duty cycles	2	CO4
LLO 11.1 Measure output voltage of step-down chopper for R load. LLO 11.2 Measure output voltage of step-down chopper for RL load.	11	*Step-down chopper for R and RL load	2	CO4
LLO 12.1 Measure frequency and output voltage of parallel inverter.	12	Performance of parallel inverter	2	CO4
LLO 13.1 Simulation of single phase midpoint Cyclo-converter with R load.	13	Single phase midpoint Cyclo-converter with R load.	2	CO4
LLO 14.1 Build / test Light dimmer circuit using DIAC-TRIAC.	14	*Light dimmer circuit using DIAC-TRIAC	2	CO5
LLO 15.1 Build / Test Emergency Light circuit using SCR.	15	Emergency Light circuit using SCR	2	CO5
LLO 16.1 Simulation of Temperature controller using SCR.	16	Temperature controller using SCR	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Build Battery charger circuit for charging a battery of 6V, 4AH.

Build fan speed regulator circuit using DIAC and TRIAC.
Build Speed control circuit for12V DC shunt motor using IGBT.
Build a circuit to control Intensity of light using phase control.
Build a circuit for Automatic street light using SCR.

Assignment

- Make Power point presentation on application of Chopper in Electric vehicle.

Make report on use of power electronics based systems in home/industrial applications.
Make a report on role of power electronic devices/system in application of EV Charging Station.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Trainer kit for SCR: Trainer kit suitable to plot anode - cathode characteristics and gate characteristics of silicon controlled Rectifier (SCR). 0 - 10V and 0 - 150V DC power supply of required current rating & 4 no of digital voltmeter & current meter are inbuilt in the kit.	1
2	Function generator: 1 MHz , sine, square, triangular, ramp and pulse generator Freq range 0.01 Hz to 1 Mhz, Output amplitude 20V open circuited, Output impedance 50 ohms. Facility to indicate output frequency & amplitude on dispay.	10
3	MATLAB-SIMULINK / Scilab software, Proteus software, Multisim software	13,16
4	Trainer kit for IGBT:Trainer kit suitable to plot characteristics of IGBT. 2 no of variable DC Power supply of required current rating & 4 no of digital voltmeter & current meter are built in the kit.	2
5	Trainer kit for DIAC :Trainer kit suitable to plot forward and reverse characteristics of Diac. 0-50V DC power supply & required digital voltmeter & current meter is inbuilt in the kit.	3
6	Trainer kit for SCR triggering circuits :Trainer kit suitable to study the basic triggering methods of SCR like Resistance triggering circuit; R-C triggering circuit; UJT triggering circuit; IC 555 triggering circuit etc. Should be provided with SCR, Lamp load (15W) & isolation transformer. Required R & C components are provided in trainer which can be interconnected by patch cords to make the desired configuration. SCR should be operated on 230V, 50Hz AC supply.	4,5
7	Trainer kit for HWR , FWR without and with Capacitor and Inductor Filter: Trainer kit shall consists of Following parts provided on PCB with connecting terminals & test points. Mains transformer primary 230V A.C. Secondary centre tap 12-0-12VAC at 500 mA. 4 diodes which can be interconnected by patch cords to make HWR, FWR circuit, Filter Choke coil, filter Capacitors, Load Resistors. Required configuration of rectifier and filter can be assembled by patch cords. Waveforms can be observed on CRO & various measurements can be done. Line & load regulation can be found out.	7,8
8	LCR Q meter: Accurate 0.01% up to 5 MHz	8,10,11
9	Regulated power supply: 0- 30 Volt, 2 A with digital display, with S.C. protection	All
10	Digital multimeter: 3.5 digit with R , V, I measurements, diode and BJT testing	All
11	CRO : Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 Mhz X10 magnification 20 nS max sweep rate, Alternate triggering ,Component tester and with optional features such as Digital Read out , USB interface	All
12	SCR(IC 2N4103),TRIAC(IC BT 139),MOSFET(IC 47N60C3),IGBT(BUP 402),DIAC (DB3/ DB4 SSD3A)any other relevant IC can be used,	All

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
13	Analog multimeter: Suitable to measure AC/DC voltage , Current and Resistance, to test power devices DC voltage Range 400mV to 1000 V AC Voltage Range 4V to 750 V ,DC current 4 mA to 10A ,AC current 4 mA to 10 A Resistance 400 Ohm to 40 M ohm or any other better specifications and facilities	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Power Semiconductor Devices	CO1	12	4	8	4	16
2	II	Triggering and Commutation methods of SCR	CO2	8	4	4	6	14
3	III	Phase controlled rectifiers	CO3	10	4	4	8	16
4	IV	Power Converters	CO4	9	4	4	6	14
5	V	Industrial applications of power electronic devices	CO5	6	2	4	4	10
Grand Total				**45**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.

For formative assessment of laboratory learning 25 marks
Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks.

End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	1	1	2	1	1			
CO2	3	-	1	1	2	1	1			
CO3	3	2	1	1	1	1	1			
CO4	2	2	2	1	2	1	1			
CO5	2	2	2	2	3	3	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	M.D. Singh, K. B .Khanchandani	Power Electronics	Tata Mc,Graw Hill ,ISBN-13: 9780070583894
2	P.S.Bimbhra	Power Electronics	Khanna Publisher, New Delhi, ISBN-10. 9788174092793
3	Rashid, Muhammad H.	Power Electronics Circuits Devices and Applications	Pearson Education India, New Delhi,ISBN-10. 9332584583
4	B.R.Gupta And V.Singhal	Power Electronics	S.K.Kataria and Sons, ISBN 10: 9350141078
5	Harish C Rai	Power electronics and Industrial application	CBS publishers ISBN-13: 9789386827869
6	Robert W.Erickson Dragan Maksimovic	Fundamental of Power Electronics	Springer,ISBN-13: 9783030438791

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://learnabout-electronics.org/Semiconductors/thyristors_63.php	Thyristor family, Thyristor protection
2	https://www.electronics-tutorials.ws/power/unijunction-transistor.html	Thyristor family devices, SMPS, Rectifiers.
3	https://www.electrical4u.com/chopper-dc-to-dc-converter/	Chopper operation
4	https://www.elprocus.com/cycloconverters-types-applications/	Cyclo-Converter
5	https://www.alldatasheet.com/	All Datasheets

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

ELECTRONIC EQUIPMENT MAINTENANCE & SIMULATION **Course Code : 314009**

Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE**
Semester	**: Fourth**
Course Title	**: ELECTRONIC EQUIPMENT MAINTENANCE & SIMULATION**
Course Code	**: 314009**

I. RATIONALE

This course is intended to help the student to develop skills of maintenance of various electronics equipment/ appliances/ gadget employed in industries as well as daily life. Students will able to use modern day electronic design automation tools for analyzing, designing and real time testing of analog, digital, mixed electronic circuits and their PCB layouts. These operations are useful in developing, fabricating and testing new prototype circuits.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry/employer expected outcome:
Maintain the electronic equipments/appliances/gadgets using Electronic Design Automation tools.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Choose a maintenance policy for specified Equipment/Appliance/Gadgets.
- CO2 - Select troubleshooting tools for the given electronic equipment.
- CO3 - Maintain electronic appliances and laboratory equipment.
- CO4 - Test the performance of electronic circuits using simulation tools.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/ s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./ Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314009	ELECTRONIC EQUIPMENT MAINTENANCE & SIMULATION	MEE	SEC	-	-	4	-	4	2	-	-	-	-	-	25	10	25@	10	-	-	50

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.

7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe different types of electronic maintenance. TLO 1.2 Explain the maintenance policy for the given equipment. TLO 1.3 Choose the service option for the maintenance of the given equipment with justification. TLO 1.4 Illustrate the procedure to install application software. TLO 1.5 Differentiate maintenance and troubleshooting process of equipment's.	**Unit - I Electronic equipment maintenance management** 1.1 Objective of maintenance management service, types of maintenance: preventive, predictive, & corrective maintenance 1.2 Maintenance policy: Concept of warranty and guarantee, equipment service options 1.3 Interpretation of the service and operation manuals, software installation procedure and policies 1.4 Maintenance versus troubleshooting versus calibration	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Describe circuit and wiring diagram of given equipment. TLO 2.2 Illustrate general troubleshooting procedure. TLO 2.3 Identify with proper justification use of relevant tools for troubleshooting of given equipment. TLO 2.4 Choose the relevant measure to troubleshoot given equipment with justification. TLO 2.5 Describe the importance of earthing in laboratories. Compare earthing and grounding for electronic system .	**Unit - II Fundamentals of troubleshooting** 2.1 Block, circuit, wiring/line diagram of available equipment 2.2 General troubleshooting procedure 2.3 General troubleshooting techniques 2.4 Fault finding tools, test and measuring instruments, temperature sensitive intermittent problems and corrective actions, situations where repairs should not be attempted 2.5 Definition of earthing, need of earthing and types of earthing, Compare earthing and grounding 2.6 Grounding and Shielding systems in electronic equipment	Presentations Lecture Using Chalk-Board
3	TLO 3.1 Illustrate common steps of maintenance of given home appliances. TLO 3.2 Describe common steps of installation of UPS and DTH. TLO 3.3 Explain working procedure of given laboratory equipment's using its block diagram. TLO 3.4 State the principle of power generation of solar PV cell. TLO 3.5 Write the installation procedure of CCTV	**Unit - III Maintenance of electronic equipments** 3.1 Electronic appliances: Operation and troubleshooting of smart weighing machine, water purifier, emergency light system, switched mode power supply (SMPS), public address (PA) system. 3.2 Installation, operation, fault finding of offline/ online uninterruptible power supply (UPS) and direct-to-home (DTH) 3.3 Laboratory equipment: Operation and testing of function generator, CRO, DSO, regulated power supply, current source, multimeter, clamp-on ammeters, EMF meter, electrometer, solenoid voltmeter, contact and non-contact type tachometer and sound level meter 3.4 Installation and testing of solar power system	Video Demonstrations Presentations Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
	Surveillance system. TLO 3.6 Explain block diagram of central processing unit.	3.5 Installation and testing of surveillance system-CCTV 3.6 Assembling of computer system	
4	TLO 4.1 State need of EDA tools. TLO 4.2 Describe the procedure to create new file in the given EDA tool software. TLO 4.3 Design given analog circuits using EDA tool. TLO 4.4 Sketch given Digital and Op-Amp based circuits using EDA tool. TLO 4.5 Design real life application using any simulation software.	**Unit - IV Simulation softwares** 4.1 Introduction to Electronic Design Automation (EDA) tools, need of simulation software. 4.2 Introduction of any available EDA tools like e-sim, Multisim, SPICE simulator, LabVIEW, Proteus, MATLAB or others. 4.3 Main features of EDA tool: Open file, create new file, run, simulation, virtual instrument, editing windows, functions, controls, file formats and report generation 4.4 Circuit analysis: Analog circuits (RL, RC, RLC),Op- Amp based circuits (inverting/ non inverting amplifiers),digital circuit (adder, multiplexer and flip flops) 4.5 Simulation of various real life applications like water level controller, temperature controller and security system.	Demonstration Video Demonstrations Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Prepare the work order for the maintenance of electronic equipment	1	*Preparation of work order for the maintenance of electronic equipment	2	CO1
LLO 2.1 Prepare Bin card for the maintenance of given electronic equipment.	2	*Preparation of Bin card for the maintenance of electronic equipment	2	CO1
LLO 3.1 Test electronic component such as loudspeaker, microphone, relays, solenoid, switches, etc. in equipment.	3	Performance of electronics components	2	CO2
LLO 4.1 Measure earth resistance of campus premises using earth tester. LLO 4.2 Test the effect of grounding and without grounding on output for the given input.	4	*Measurement of earth resistance of campus premises using earth tester	2	CO2
LLO 5.1 Test the voltage at different output points of regulated power supply. LLO 5.2 Rectify the fault of regulated power supply.	5	*Troubleshooting the regulated power supply	2	CO3
LLO 6.1 Rectify the fault of techometer.	6	*Troubleshooting of speed measuring devices	2	CO3
LLO 7.1 Troubleshoot the clamp-on ammeter.	7	*Troubleshooting of clamp-on ammeter	2	CO3
LLO 8.1 Install DTH unit. LLO 8.2 Test the performance of DTH unit.	8	*Installation of Direct To Home(DTH) system	2	CO3
LLO 9.1 Carry out preventive maintenance of sound level meter.	9	Preventive maintenance of sound level meter	2	CO3
LLO 10.1 Calibrate the given smart weighing machine.	10	Calibration of smart weighing machine	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Test the performance of water purifier.	11	Troubleshooting of water purifier	2	CO3
LLO 12.1 Install offline/online UPS. LLO 12.2 Test the performance of online/ offline UPS.	12	Installation of offline/online UPS	2	CO3
LLO 13.1 Install CCTV network in institute premises.	13	*Installation of closed circuit television (CCTV)	2	CO3
LLO 14.1 Install solar power system. LLO 14.2 Test the solar power system.	14	*Installation and testing of solar power system	2	CO3
LLO 15.1 Rectify the fault of function generator.	15	*Troubleshooting of function generator	2	CO3
LLO 16.1 Rectify the fault of SMPS.	16	Troubleshooting of switch mode power supply (SMPS)	2	CO3
LLO 17.1 Rectify the fault of CRO.	17	Troubleshooting of Cathode ray oscilloscope (CRO)	2	CO3
LLO 18.1 Rectify the fault of DSO.	18	*Troubleshooting of digital storage oscilloscope (DSO)	2	CO3
LLO 19.1 Install available EDA tool software. LLO 19.2 Create new file, open file, run and simulate in given EDA tool.	19	*Installation of electronic design automation (EDA) tools	2	CO4
LLO 20.1 Measured AC voltage and current in RL, RC, RLC circuit using EDA tools	20	*Measurement of AC voltage and current in RL, RC and RLC circuit using EDA tools	2	CO4
LLO 21.1 Test the output of regulated power supply circuit at different points using EDA tool.	21	*Simulation of regulated power supply using EDA tools	2	CO4
LLO 22.1 Test the output of half wave rectifier circuit using EDA tool.	22	Simulation of half wave rectifier circuit using EDA tool	2	CO4
LLO 23.1 Test the output of full wave bridge rectifier circuit using EDA tool.	23	Simulation of full wave bridge rectifier circuit using EDA tool	2	CO4
LLO 24.1 Simulate inverting amplifier using IC741. LLO 24.2 Simulate non-inverting amplifier using IC741.	24	*Simulation of OP-AMP circuit (IC741) using EDA tools	2	CO4
LLO 25.1 Simulate half adder circuit to verify the truth table. LLO 25.2 Simulate full adder circuit to verify the truth table.	25	Simulation of Adder circuit using EDA tools	2	CO4
LLO 26.1 Simulate 8:1 multiplexer circuit to verify the truth table.	26	*Simulation of 8:1 multiplexer circuit using EDA tools	2	CO4
LLO 27.1 Simulate 1:8 demultiplexer circuit to verify the truth table.	27	Simulation of 1:8 demultiplexer circuit using EDA tools	2	CO4
LLO 28.1 Simulate JK flipflop circuit to verify the truth table.	28	Simulation of JK flipflop circuit using EDA tools	2	CO4

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Smart weighing machine Connection to the app for smartphone with simple operation and full data control. Bluetooth 4.0 function, compatible for IOS and android.	10
2	UPS Standby UPS: 5-12 ms, – average 8 ms Line-interactive UPS: 3- 8ms – average 5 ms The double conversion has a zero seconds transfer time	12
3	CCTV system Set up of CCTV installation sample-(4 CH DVR ,hard disk 500GB,IR dome camera, video cable, power supply (12V,1 Amp), regulated for controller and driver circuit, 4 CCTV cameras along with the digital video recorder (DVR)	13
4	Solar Power Trainer Kit Solar training kit/simulator with built in meters for DCV, DCA, AC multifunction meter 9 for ACI, ACV power frequency, protection circuits, BS-10 terminals for making the connection, single/dual axis tracking system.	14
5	Function generator Frequency Output : 15 MHz - sine, square & triangle. 6 MHz - pulse, TTL and arbitrary. Output Channels : 2, Channels sampling rate : 266 MSa/S (vertical resolution - 14 Bits) Waveforms : sine, square, pulse (adjustable duty cycle, precise adjustment of pulse width & period), triangular Wave	15
6	SMPS power supply Input voltage: AC 100 - 240V 50 / 60Hz Output voltage: 24V DC, 5A Adjustment range: ±20%	16
7	Cathode ray oscilloscope Bandwidth: 0 to 15 MHz Mode : auto/level/free run Power : 230 V ± 10% 50 Hz 30W	17
8	Digital Storage Oscilloscope 100MHz DSO with colour display, 1GSa/Sec sampling rate, with USB PC interface cable and software, with USB device & host	18
9	Simulation software like e-sim, Multisim, Scilab,SPICE simulator, LabVIEW, Proteus, MATLAB or any other.	19,20,21,22,23,24,25,26,27,28
10	Microphone and loudspeaker characteristics trainer kit On board Meters : dB meter Range : 40-80dB, 80-120dB	3
11	Multimeter 3 ½ -digit display with AC and DC voltage and current measurement facility, Diode, resistor, capacitor testing facility.	3,15,17,18
12	Regulated power supply Range: 0-30 V, 0-2 A DC	3,5
13	Digital Earth Resistance Tester with Kit Digital resistance earth tester for 0 – 10 / 100 / 1000 ohms 4 terminal with testing kit and cables.	4
14	Tachometer Voltage: ±5 V, 0 - 10 V, etc. Current: 0 - 20mA, 4 -20 mA, 10 - 50mA, etc.	6

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
15	Clamp-on ammeter AC current: 40.00 A / 400.0 A Continuity:<=30ohm Capacitance: 0 to 100.0 uF / 100uF to 1000 uF Frequency: 5.0 Hz to 500.0 Hz	7
16	DTH system Input power: AC 90 ~ 240V, 50 / 60 Hz Serial connection (RS-232) RF modulator	8
17	Sound level meter Measurement range : LP :30~130dB (A) Resolution : 0.1 dB Accuracy : ±1.5dB	9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Each practical will be assessed considering: - 60% weightage to process and 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End of the term assessment, Viva-voce, workshop / Lab performance

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	-	-	-	-	-	-	2			
CO2	-	-	-	-	-	-	2			
CO3	2	2	2	3	2	-	2			
CO4	2	2	3	3	-	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Khandpur R.S.	Troubleshooting electronic equipments	Mc Graw Hill, 2006 ISBN: 9780071477314
2	Tomal Daniel R., Ph.D. Agajanian Aram S. , Ph.D.	Electronic Troubleshooting	Mc Graw Hill, 2014 ISBN: 9780071828611

Sr.No	Author	Title	Publisher with ISBN Number
3	Singh Sudeep K.	Trouble Shooting & Maintenance of Electronic Equipment	S K Kataria and Sons, 2008 ISBN: 9789381348178
4	Kumar Ashok L. Indragandhi V. Maheswari Uma Y.	Software Tools for the Simulation of Electrical Systems	Academic Press, 2020 ISBN: 9780128194164
5	Gupta R. G.	Electronic Instruments And Systems: Principles, Maintenance And Troubleshooting	Tata Mcgraw-Hill, 2001 ISBN: 9780074636299
6	Robert L. Boylestad, Nashelsky Louis	Electronics Devices and Circuit Theory	Pearson Education India,2013 ISBN: 9789332559059
7	Sharma Chanchal Dr.	Electronic Equipment Maintenance	All India Council for Technical Education (AICTE) ISBN : 9788196183400

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.eit.edu.au/resources/practical-troubleshooting-o f-electronic-circuits-for-engineers-and-technicians/	Practical Troubleshooting of Electronic Circuits for Engineers and Technicians
2	https://www.multisim.com/	Multisim software download link
3	https://esim.fossee.in/downloads	Open-source EDA tool esim for simulation
4	https://www.scilab.org/download/scilab-2024.0.0	Scilab is a free and open-source, cross-platform numerical computational package
5	https://downloads.digitaltrends.com/labview/ windows	LabView software
6	https://logisim.software.informer.com/download/ #download_con tent	Logisim software
7	https://cloud.scilab.in/	Scilab on cloud facilitates execution of the codes for particular example(s) online.
8	https://easyeda.com/	An easier and powerful online PCB design tool

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students