

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 be 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	Paper Duration	Assessment Scheme						Total Marks	
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL			Based on SL		
				CL	TL	LL			FA-TH		SA-TH	Total	Practical				
				Max	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

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.
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 Surveillance system. TLO 3.6 Explain block diagram of central processing unit.	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 3.5 Installation and testing of surveillance system-CCTV 3.6 Assembling of computer system	Video Demonstrations Presentations Hands-on
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
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

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
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 - <ul style="list-style-type: none"> • '*' 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

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
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: $\pm 20\%$	16
7	Cathode ray oscilloscope Bandwidth: 0 to 15 MHz Mode : auto/level/free run Power : 230 V $\pm 10\%$ 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 $\frac{1}{2}$ -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
15	Clamp-on ammeter AC current: 40.00 A / 400.0 A Continuity: $\leq 30\text{ohm}$ Capacitance: 0 to 100.0 μF / 1000 μF to 1000 μF 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 : $\pm 1.5\text{dB}$	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
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-of-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

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Sr.No	Link / Portal	Description
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_content	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

MSBTE Approval Dt. 21/11/2024**Semester - 4, K Scheme**