GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma in Engineering

Level: Diploma

Branch: Automation and Robotics

Course / Subject Code: DI01041011

Course / Subject Name: Principles of Electronics in Automation

w. e. f. Academic Year:	2024-25
Semester:	1st
Category of the Course:	PCC

Prerequisite:	Basic Electrical and Electronics Fundamentals
Rationale:	The engineering diploma holders are required to use and maintain various types of electrically and electronically operated and controlled device/equipment. The fundamental principles of electrical and electronics are to be applied in most of the situations to arrive at the probable solutions which is faced in the world of work, there for the knowledge of the functions of various basic electrical and electronic devices and components required. Practical skills acquired through the laboratory experiments will help them, when they work with electrical or electronic equipment and its circuits or sub circuits. This course is designed to develop the skills to use the basics electrical and electronic devices/components and apply the knowledge to maintain the various types of electrical and electronic circuits and equipment.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Apply Basics/Fundamentals of Electrical energy (DC/AC) in real life application.	A
02	Apply various fundamental laws of electricity.	A
03	Demonstrate the function of various electrical devices.	U
04	Demonstrate the function of various electronic devices.	U
05	Implement various techniques for e-waste disposal in benefit of society & environmental consideration.	R

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage

1.	• Introduction of conductor and insulator.
	• D.C. circuit parameter:
	  ○ Electric Charge, Electric Current, Electric Power, Electrical Energy, EMF Potential difference.
	• Ohm's law
	• Basic Electrical circuit components:
	  ○ Resistor, inductor, capacitor (R, L and C) Series and Parallel connection of R, L and C.
	• A.C. circuit parameters:
	  ○ Cycle, Frequency, Time period, Amplitude, RMS value, Average value, Instantaneous value, Peak Value, Impedance, Reactance
	• Pure resistor, inductor and capacitor with DC and AC supply.
		9	19

2.	• Basic Electrical laws and rules:
	  ○ Kirchhoff's voltage law.
	  ○ Kirchhoff's current law.
	• Electromagnetic Induction:
	  ○ Statically and dynamically induced EMF
	  ○ Self and Mutual inductance
	  ○ Faraday's law
	  ○ Lenz's law
		10	24

	○ Fleming's right-hand rule for Generator ○ Fleming's left-hand rule for Motors. • Electrical Devices: ○ Different types of Transformers: Step-up, Step-down, Isolation, and Auto transformer ○ Construction and working of DC Motor ○ Construction and working of AC Motor		
3.	• Brief introduction to semiconductor. • Semiconductor material: ○ Intrinsic type ○ Extrinsic type (P-type and N-type) • Comparison of Conductor, Semiconductor and Insulator • Basic Semiconductor devices: ○ Symbol of PN junction diode, Zener diode, LED, Photo diode, photo transistor ○ V-I Characteristics of P-N junction diode, Zener, diode, LED, photo diode, photo transistor • Identify terminals of various semiconductor devices using DMM or CRO.	9	19
4.	• Rectifier Circuits: Half Wave and Full Wave Rectifier (center tapped and bridge). • Transistor: ○ Basic structure and working of NPN and PNP transistor. ○ Transistor Parameters: Input resistance, Output resistance, current gain. • Transistor mode of operation: ○ Cut-off, active, saturation. ○ Types of transistor configurations: ○ CE, CB, and CC transistor configuration circuit, working and V-I Characteristic. • Testing of transistor with DMM or CRO. ○ Transistor as a switch and amplifier. ○ Photo diode and photo transistor as opto-isolator.	12	29
5.	• Concept of electronic waste. • Sustainability and electronic waste.	5	09

	• Methods to handle electronic waste. • Disposal of electronic waste.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
17	**26**	**27**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	Basic Electrical and Electronics Engineering	S. K. Bhattacharya	PEARSON India, 2011. ISBN: 978-8131505564
2	A text book of Electrical Technology-Vol.1 & 2.	Theraja B. L.	S. Chand Publication ISBN:9788121924375
3	Grob's Basic Electronics.	Mitchel E. Schultz	McGraw Hill, 2017. ISBN: 978-0070634329
4	Electronic devices: electron flow version, 9th edition.	Thomas L. Floyd	PEARSON India, 2015. ISBN: 978-9332545496
5	Electronic principles, Eighthedition.	Albert Malvino, David J. Bates	McGraw Hill, 2015. ISBN: 978-0073373881
6	Principles of electronics.	V.K.Mehta & Rohit Mehta	S. Chand, New Delhi, 2014, ISBN: 978-8121924504
7	E-Waste: Management and Procurement of Environment	Suresh Kumar, Jatindra KumarPradhan	Authors press 2021,ASIN : B095PR6MVS

8	Solid and Liquid Waste Management Waste toWealth	Rajaram Vasudevan, Siddiqui Faisal Zia , Agrawal Sanjeev	PHI Learning Pvt. Ltd. New DelhiISBN: 9788120352452

(b) Open source software and website:

- www.datasheetcafe.com
- www.williamson-labs.com
- www.learnerstv.com
- www.cadsoft.io
- www.nptel.iitm.ac.in
- www.khanacademy
- www.vlab.co.in
- www.alldatasheet.com
- www.electronics-tutorials.ws
- www.instructables.com/Basic-Electronics
- www.makerspaces.com/basic-electronics
- https://www.electrical4u.com/types-of-resistor (for Resistor)
- https://www.electronicshub.org/types-of-diodes/ (for Diodes)
- https://nptel.ac.in (for online courses and video of all engineering branches)
- www.electronics4.com (for basic electronic projects and technical videos)
- https://cpcb.nic.in/e-waste/ (For E-waste Recycle guidelines)

Suggested Course Practical List:

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Use Digital Multimeter to measure basic electrical parameters like current, voltage and resistance.	1	02
2	Verify Ohm's law.	1	02*
3	Measure various parameters related to AC signal using Cathode RayOscilloscope.	1	02*

4	Draw the response of R, L, and C load with DC supply.	1	02
5	Draw the response of R, L, and C load with AC supply.	1	02
6	Calculate resistance value of series and parallel combination of resistors.	1	02*
7	Verify Kirchhoff's current law.	2	02*
8	Verify Kirchhoff's voltage law.	2	02*
9	Demonstrate function of transformer	2	02
10	Demonstrate function of DC motor	2	02
11	Demonstrate function of AC (induction) motor	2	02
12	Test Conductor, Semiconductor and Insulator.	3	02
13	Build circuit and obtain V-I characteristic of PN junction diode.	3	02
14	Build circuit and obtain V-I characteristic of Zener diode.	3	02*
15	Build circuit and obtain V-I characteristic of photo diode	3	02*
16	Build circuit and obtain V-I characteristic of photo transistor.	3	02
17	Test/identify terminals of the diode and transistor.	3	02
18	Build circuit of half wave rectifier and measure/obtain output voltage waveform using Cathode Ray Oscilloscope.	4	02*
19	Build circuit of full wave rectifier and obtain/observe output voltagewaveform using Cathode Ray Oscilloscope.	4	02*
20	Build circuit and obtain V-I characteristic of common emitter transistorconfiguration.	4	02*
21	Build circuit and obtain V-I characteristic of common base transistor configuration.	4	02*
22	Build circuit of common emitter transistor configuration and obtain thevalue of current gain and input impedance.	4	02*
23	Build circuit of common base transistor configuration and obtain thevalue of current gain and input impedance.	4	02*
24	Build circuit of common collector transistor configuration and obtain the value of current gain and input impedance.	4	02
25	Select transistor for particular application using transistor datasheet.	4	02
26	Verify function of transistor as a switch.	4	02

27	Verify function of transistor as an amplifier.	4	02*
28	Test/verify function of photo diode as Opto-isolator.	4	02
29	Test/verify function of photo transistor as Opto-isolator.	4	02
30	Describe method to dispose electronic waste	5	04
	Minimum 14 Practical Exercises		**30**

Note:

I. *More Practical Exercises can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

II. *Care must be taken in assigning and assessing study report as it is a first year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.*

The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed Practical Exercises of this course required which are embedded in the COs and ultimately the competency.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

List of Laboratory/Learning Resources Required:

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No	Equipment Name with Broad Specifications	PrO. No.
1.	Digital Multimeter: 3 1/2 digit display, 9999 count digital multimeter measures: Vac, Vdc (1000V max), Adc, Aac (10 amp max), Resistance (0 – 2 Mega Ohm), diode and transistor tester.	1 to 30
2.	Cathode Ray Oscilloscope, Dual Trace 20Mhz, 1MegaΩ Input Impedance.	1,3,5,9,14 to 24,26 to 29
3.	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	2, 4,18,19,27
4.	Electronic Workbench: Bread Board 840 -1000 contact points: Positive and Negative DC power rails on opposite sides of the board with , 0-30 V , 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO 0-30MHz , Digital Multimeter	1 to 29
5.	Dual variable DC power supply ,0- 30V, 2A, With Short circuit protection, separate display for voltage and current	1,2,3,5 to 8,10,12 to 24,26 to 29
6.	Discrete Component Trainer/ Analog Component Trainer: Fixed and variable D.C. Supplies, AC Supplies, Actual Components like transistors, LDR, photo diode, resistors, capacitors, inductors,diodes, LED's, transformers, 2 mm patch cords for interconnecting components.	1 to 29
7.	Single phase auto-transformer: Single phase, 0- 230 V, 10 A.	1,2,4,11,18,19

Suggested Project List:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5).

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about 14- 16 week (fourteen to sixteen) student engagement hours

during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.
A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

Using various fundamental knowledge of electrical and electronics engineering students may develop mini/micro projects based on team/individual basis which concrete their fundamentals of electronics hardware and can work as prototypic models in various societal applications.

Electronic waste: Compile a report of handling electronic waste with figures, tables and comparative charts and strategies used and suggested.

Suggested Activities for Students:

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

a) Prepare charts/display boards of some electrical/electronic devices with their specification.
b) Prepare a table and interpret the technical specification of various diodes and transistors using data sheet.
c) Undertake mini/micro-projects in teams/individual basis
d) Give seminar on any relevant topic.
e) Undertake a market survey of various types of hardware components.
f) Prepare a survey report different electronic waste management adopted by the local electronics industry.
g) Undertake a visit to e-waste handling plant nearby and prepare a report.
h) Prepare showcase portfolios.

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