GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester: I

Course Title: Elements of Electrical & Electronics Engineering
(Course Code: 1313202**)**

Diploma program in which this course is offered	Semester in which offered
Information and Communication Technology	First

1. RATIONALE:

The Information and Communication Technology diploma holders are required to use and maintain various types of electrical and electronics communication equipments. The knowledge of the concepts of basic electrical engineering with the functions of various basic electronic devices and components and practical skills acquired through the laboratory experiments will help the diploma holders to arrive at the probable solutions when they work with electrical and electronic equipment and its sub-circuits. This course is designed to develop the skills to use the basics electronic components and apply the knowledge to maintain the various types of electrical and electronics circuits.

2. COMPETENCY:

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

- · Apply basic principles of electrical and electronics in various engineering applications.

3. COURSE OUTCOMES (COs):

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Use D.C. and A.C. fundamentals to solve basic problems of electrical and electronics engineering.
b) Demonstrate the functionality of Semiconductor diodes.
c) Demonstrate the characteristics and functions of different types of semiconductor diodes.
d) Build and test the different types of rectifiers using PN junction diode.
e) Compare and apply various transistor configurations.

GTU - COGC-2021 Curriculum

4. TEACHING AND EXAMINATION SCHEME:

Teaching scheme			Total credits (L+T+P/2)	Examination scheme				
				Theory marks		Practical marks		Total marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30	70	25*	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical;
C – Credit, CA - Continuous Assessment; ESE -End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES:

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	To Verify Ohm's Law.	1	2*
2	Verify Kirchoff's current law and Kirchoff's voltage law in the given electric circuit.	1	2*
3	Verify Superposition theorem and determine the current and voltage in each branch of the given circuit.	1	2
4	Verify the Thevenin's theorem and determine the voltage and current in the given branch of the circuit.	1	2*
5	Verify the Norton's theorem and determine the voltage and current in the given branch of the circuit.	1	2
6	Test the performance of PN junction diode and obtain forward Voltage drop and diode current.	1	2*
7	Build and test the half wave rectifier on a breadboard.	4	2*
8	Build and test the output of the full wave center tap rectifier on a bread board.	4	2*
9	Build and test the full wave bridge rectifier on a breadboard.	4	2*
10	Test the performance of half and full wave rectifier with π filter.	3	2*
11	Test the performance of the zener diode and obtain the Zener breakdown (Reverse) voltage and current	3	2*
12	Build and test zener voltage regulator for the given regulated voltage.	3	2*
13	Test the performance of LED and measure the current and voltage.	3	2*
14	Test common emitter transistor configuration and obtain the	5	2*

	current gain and input impedance.		

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 safety measures and practices	10
4	Record and plot observations correctly	20
5	Interpret the result and conclude	30

6. MAJOR EQUIPMENTS/ INSTRUMENTS REQUIRED:

These major equipments 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	Resistance load bank 03-05 Kw	1 to 5
2	Analog ammeter (0-5/10 Amps)	1 to 5
3	Wattmeter (AC/DC, 0-1500 Watts)	1 to 5
4	Single phase Variac (0-260 Volts)	1 to 14
5	Digital Multimeter: 3 1/2 digit display, 1999 count digital multimeter measures: Vac, Vdc (600V max) , Idc, Iac 1,4,5,6,7,8,9, (10 amp max) , Resistance (0-2 MΏ) with diode and transistor tester	1 to 14
6	Mili Ammeter (0-100 mA)	6 to 14
7	Dual variable DC power supply ,0- 30V, 2A, With Short circuit protection, separate display for voltage and current	6 to 14
8	Cathode Ray Oscilloscope, Dual Trace 20 MHz, 1 MΩ Input Impedance	6 to 14
9	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	6 to 14
10	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 0-2 MHz, CRO 0-30 MHz , Digital Multimeter	6 to 14

7. AFFECTIVE DOMAIN OUTCOMES:

The following sample Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Follow safety precautions.
d) Realize importance of E-waste management

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY:

The major underpinning theory is given below based on the higher level UOs of Revised Bloom's taxonomy that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major Learning Outcomes	Topics and sub-topics
Unit - I Fundamentals of Electrical Circuits (D.C. & A.C.) and Network Theorems	1a Define the various electrical parameters and determine the current, voltage and resistance in an electric circuit using Ohm's Law. 1b Identify the commonly used materials and components used in electrical engineering. 1c Define the terms work, power and energy. 1d Calculate voltage and current in the given resistive circuits using KCL and KVL. 1e Calculate voltage and current of resistive circuits using Mesh and nodal analysis method. 1f Classify types of electrical circuits. 1g Calculate voltage, current and resistance using Superposition Theorem, Thevenin's Theorem, Norton's Theorem. State Reciprocity Theorem. 1h Explain generation of alternating EMF., Define various electrical parameters, Derive equation for RMS and average, value of sinusoidal wave. 1i Compare the behavior of AC voltage, current and power through pure resistive, pure inductive and pure capacitive load. Define the terms active power, reactive power and power factor	1.1 Charge, Current, Potential, voltage, power, Energy Electrical Resistance and its Unit, Ohms law: applications and limitations Specific Resistance and its unit. Parameters affecting the resistance, Effect of temperature on resistance and temperature co-efficient, potential difference ; EMF 1.2 Conductors, Insulators, semiconductors, capacitors and inductors. 1.3 Definitions of Work, Power and Energy (both electrical and mechanical). 1.4 Concept of Open circuit, Closed circuit, Short circuits, Definitions of node, branch, loop, mesh, Kirchhoff's laws and simple numerical, Kirchhoff's Voltage and Current law (KVL and KCL). 1.5 Mesh Analysis and Nodal Analysis of Networks. 1.6 Linear & Nonlinear circuit, Active and Passive Network. 1.7 Super Position Theorem, Thevenin's Theorem, Norton's Theorem Maximum Power Transfer Theorem, Reciprocity Theorem. 1.8 Principle of generating an alternating voltage, 2 Cycle, Time period, Frequency, Amplitude, Phase and Phase difference, Average value, R.M.S. value, Form factor, Peak Factor and Power Factor. 1.9 Waveforms, phasor diagram and expression of voltage, current and power

	with power triangle, the concept of lag and lead.	in pure: Resistance, Inductance and Capacitance. Active, reactive and apparent power (Lagging, leading power and unity power factor).
Unit - II Semiconductor Theory	2a Explain atomic structure and conductivity 2b Explain Energy band diagram and Conductor, semiconductor and Insulators 2c Describe Semiconductors and conductivity	2.1 Structure of atom of trivalent, tetravalent pentavalent materials, valence electron, free electrons, energy levels 2.2 Energy band diagram of conductor, semiconductor and insulator 2.3 Doping, Intrinsic semiconductor, extrinsic semiconductor 2.4 P-type and N-type semiconductor, majority - minority charge carrier and conductivity.
Unit - III PN junction Diodes	3a Describe the working, characteristics and applications of P-N junction diode. 3b Describe the working, characteristics and applications of Zener diode. 3c Describe the working, characteristics and applications of LED, OLED, Photodiode, Laser diode, Varactor Diode	3.1 P-N junction, Depletion layer, knee voltage 3.2 P-N junction diode forward bias, reverse bias working 3.3 P-N junction diode voltage-current characteristics 3.4 Zener diode: Working, characteristics and applications 3.5 Working characteristics and applications of LED, OLED, Photodiode, Laser diode, Varactor Diode 3.6 Diodes data sheet
Unit - IV PN junction diodes applications	4a Describe performance of various types of rectifiers. 4b Discuss function of rectifier filters 4c Describe Zener diode voltage regulator	4.1 Rectifier: Need of rectifier 4.2 Types of rectifiers: Half wave rectifier, Full wave centre tap and bridge rectifier, circuit operation, input-output waveforms, output voltage, ripple frequency, ripple factor, PIV of a diode, efficiency of half wave and full wave rectifiers 4.3 Need of rectifier filter, Types of filter: Shunt capacitor filter and π filter 4.4 Zener diode as a voltage regulator
Unit - V Transistors	5a Differentiate between PNP and NPN transistor constructions, working and their applications. 5b Differentiate different types of transistors configurations. 5c Introduction to FET (JFET and MOSFET) 5d Justify the need of electronic	5.1 Symbol, Construction, Characteristic and Working of BJT (NPN and PNP transistors). 5.2 Transistor CE, CB and CC configurations: circuit diagram, input and output characteristics. Different regions of characteristics (cutoff, active and saturation), input resistance, output resistance, current gain. 5.3 Relation between current gains alpha

	waste methods.	and beta. 5.4 Symbol, Construction, Characteristic, working of JFET and MOSFET. 5.5 Concept of electronic waste.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN:

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Electrical Circuits (D.C. & A.C.) and Network Theorems	14	8	7	3	18
II	Semiconductor Theory	6	6	4	2	12
III	PN junction Diodes	6	4	6	2	12
IV	PN junction diodes applications	8	2	4	8	14
V	Transistors	8	4	8	2	14
Total		**42**	**24**	**29**	**17**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

10. SUGGESTED STUDENT ACTIVITIES:

Other than the classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course.

Students should 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. For micro project reports should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare a table and interpret the technical specification of various diodes and transistors using data sheet
b) Undertake mini/micro-projects in teams/individual basis
c) Collect information and give seminar on any relevant topic related with the course.
d) Undertake a market survey of different semiconductor components.
e) Prepare a survey report different electronic waste management adopted by the local electronics industry.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any):

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) 'L' in section No. 4 means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About 20% of the topics/sub-topics which are relatively simpler or descriptive in nature is to be given to the students for self-learning, but to be assessed using different assessment methods.

e) With respect to section No.10, teachers need to ensure to create opportunities and provisions for co-curricular activities.
f) Guide students to find micro project using electronic components through internet.
g) Guide students on how to address issues on environment and sustainability and Introduce E-waste recycling technology among the students

12. SUGGESTED MICRO-PROJECTS:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, in the fifth and sixth semesters, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about 14- 16 (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:

a) Build a circuit for +5Vdc unregulated power supply using half wave rectifier on general purpose PCB.
b) Build a circuit for +12Vdc unregulated power supply using center-tap full wave rectifier or bridge rectifier on general purpose PCB.
c) Build a circuit using LED and rectifier which shows the working of LED as indicator on general purpose PCB.
d) Build a circuit voltage regulator using zener diode on general purpose PCB.
e) Build a circuit of common emitter amplifier using transistor and prepare a mini project report.
f) Electronic Waste: Prepare a report of strategies regarding handling of electronic waste with figures, tables and comparative charts.

13. SUGGESTED LEARNING RESOURCES:

Sr No.	Title of Book	Author	Publication with place, year and ISBN
1	A text book of Electrical Technology-Vol.1	Theraja, B. L.	S. Chand & Co. Ltd., 2011 or latest edition
2	Principles of Electrical Engineering	Gupta, B.R.	S.K. Kataria,2012 or latest edition
3	Basic Electronics and Linear Circuits	N.N. Bhargava , D.C. Kulshreshtha , S.C. Gupta	McGraw Hill Education, ISBN: 9781259006463
4	Principles of Electronics	V.K.Metha, Rohit Mehta	S. Chand, New Delhi, 2014, ISBN: 978-8121924504
5	Electronics principles	A.P. Malvino	Tata McGraw Hill
6	E-Waste: Management and Procurement of Environment	Suresh Kumar, JatindraKumar Pradhan	Authors press 2021, ASIN : B095PR6MVS
7	A Course in Electrical Technology Vol. I	Gupta ,J.B.	S.K. Kataria& Sons, 2012

			or latest edition

14. SOFTWARE/LEARNING WEBSITES:

a) Electronics Work bench
b) Multisim for Analog and Electronics Circuit design and simulation.
c) Electric Circuit Studio

15. MAGAZINES / JOURNALS:

a) Electronics for You
b) ELE Times
c) Electronic Product Magazine
d) Fierce Electronics
e) Electronics Sourcing
f) Electronics World

16. PO-COMPETENCY-CO MAPPING:

Semester 1	**Elements of Electrical and Electronics Engineering (Course Code: 1313202)**						
	POs						
Competency & Course Outcomes	(1) Basic & Discipline specific knowledge	(2) Problem Analysis	(3) Design/ development of solutions	(4) Engineering Tools, Experimentation &Testing	(5) Engineering practices for society, sustainability & environment	(6) Project Management	(7) Life long learning
(1) Use D.C. and A.C. fundamentals to solve basic problems of electrical and electronics engineering.	3	2	1	2	2	---	3
(2) Demonstrate types of semiconducting materials and it's functionalities.	3	---	---	2	2	1	3
(3) Demonstrate the characteristics and functions of different types of semiconductor diodes.	3	---	1	2	2	1	3
(4) Build and test the different types of rectifiers using PN junction diode.	3	1	2	2	1	2	3
(5) Compare and apply various transistor configurations.	3	1	1	2	1	---	3

Competency: · Apply basic principles of electrical and electronics engineering in various applications in engineering.

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE:

GTU Resource Persons

Sr No.	Name and Designation	Institute	Contact No.	Email
1	Mr T. P. Chanpura, HOD-E.C., BoS Member-ICT	Govt. Polytechnic for Girls, Ahmedabad		
2	Mr S. G. Valvi, Lect. E.C.	Govt. Polytechnic for Girls, Surat	9427179115	gpgsecsgv@gmail.com
3	Mr R. D. Modi, Lect, Elect.	K. D. Polytechnic, Patan.	9898163117	rakeshmodi11101980@gmail.com