GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
I/II – Semester

Course Title: Basics of Electrical and Electronic Engineering
(Course Code: 4300014)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering, Environment, Mining, Chemical, Plastics Engineering	First
Mechanical Engineering, Automobile , Metallurgy , Marine Engineering, Fabrication , Ceramics	Second

1. RATIONALE

Electrical engineering is one of the core engineering, which every common man uses in day to day life. This course is offered in all branches of engineering. Need of knowledge about fundamental electrical concepts for every branch is considered for this course.

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 the basic principles of electrical and electronics engineering in relevant engineering discipline 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) Apply fundamentals of DC circuits and batteries in relevant engineering discipline.
b) Apply fundamental of AC circuits in relevant engineering discipline.
c) Use electrical and electronics instruments for measuring various parameters.
d) Distinguish various electrical machines based on their working and applications.
e) Classify green energy sources with emphasis on working of solar and wind power plant.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
--	2	2	3	--	--	25*	25	50

(*): *For this practical only course, 25 marks under the practical CA has two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15 marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

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

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the 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'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify resistors, inductors and capacitors.	I	02*
2	Verify Ohm's law in the given electric circuit.	I	02
3	Verify Kirchhoff's current law in the given electric circuit.	I	02
4	Verify Kirchhoff's voltage law in the given electric circuit.	I	02
5	Find equivalent resistance for series connection.	I	02
6	Find equivalent resistance for parallel connection.	I	02
7	Find equivalent voltage for series and parallel connection of batteries.	I	02
8	Measure voltage, current and power in the given DC circuit.	I	02
9	Measure voltage, current and power and power factor in single phase AC circuit.	II	02*
10	Measure various parameters for generated wave using function generator and CRO.	II	02
11	Carry out following wiring: (1) Staircase (2) Godown.	II	02
12	Calculate unit consumption for given electrical load.	II	02
13	Test the operation of protective devices like Fuse, MCB and ELCB.	II	02
14	Identify electronic components like types of diodes, transistors, SCR.	III	02*
15	Use digital meters like multi-meter, clip-on meter for measuring various parameters	III	02*
16	Identify various transducers available in the laboratory.	III	02
17	Measure output voltage of half wave and full wave rectifier.	III	02
18	Identify various parts of DC machines stating its function	IV	02
19	Identify various parts of AC machines stating its function	IV	02
20	Measure output voltage of the given single-phase transformer.	IV	02*
21	Identify components of solar power system stating its function.	V	02*
22	Identify components of wind power system stating its function.	V	02*
	Minimum 14 Practical Exercises		**28 Hrs.**

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. 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..*

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

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Variable DC power supply: 0- 30V, 2A, Short Circuit protection, display for voltage and current	8
2	Discrete Component Trainer/ Analog Component Trainer: Fixed and variable D.C. Supplies, AC Supplies, Actual Components like transistors, SCR, LDR, photo diode, resistors, capacitors, inductors, diodes, LED's, transformers, 2 mm patch cords for interconnecting components	1 to 7, 13, 15,16
3	Auto-transformer: Single phase, 0- 230 V ,0-260 V, 8A	9,14,19
4	Digital Multimeter: 3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max), Resistance (0 - 100 MΩ) , Capacitance and Temperature measurement	2 to 9, 12,14,16,19
5	Demonstration model for staircase and godown wiring.	10
6	Demonstration model for operation of fuse, MCB, ELCB and RCCB.	11
7	Clamp on meter: AC/DC current up to 40 A, 600 V	2 to 9, 12,14,16,19
8	Cut section of AC and DC rotating machines	17,18
9	Solar Energy demonstration Kit (Meters, Chargeable Batteries, with sample load)	21
10	Wind Energy demonstration kit or Wind turbine working Model (Small capacity)	22

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 fulfil the development of this course competency.

a) Work as a leader/a team member.

b) Follow safety practices while using electrical equipment.
c) Realize the importance of green energy. (Environment related)

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 higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I DC Circuits	1a. Distinguish basic electrical components. 1b. Explain effect of temperature on resistance. 1c. Determine voltage, current and resistance in electrical circuit using Ohm's law. 1d. Apply Kirchhoff's voltage and current law for given electrical circuit. 1e. Calculate equivalent resistance for given connection. 1f. Select relevant battery for given application.	1.1 Concept of Electric Potential, EMF, Current, Power and Energy 1.2 Resistor, Inductor and Capacitor 1.3 Effect of temperature on resistance of conductor 1.4 Ohm's law: Applications and limitations 1.5 Kirchhoff's voltage law and Kirchhoff's current law 1.6 Types of connections: series and parallel connections of resistors 1.7 Battery: Concept of cell and battery, Rating of battery, Series and parallel connection of batteries, Applications
Unit – II AC Circuits and Wiring	2a. Interpret parameters related to alternating waveform. 2b. Describe behavior of pure resistor, inductor and capacitor with AC supply. 2c. Explain concept of power triangle and power factor. 2d. Interpret given wiring diagram. 2e. Justify the need of electrical safety and protective device.	2.1. Basic Terminology: Cycle. Time-period, Amplitude, Frequency, RMS value. Average value, Form factor, Peak factor 2.2. Pure resistor, inductor and capacitor with AC supply 2.3. Power triangle and power factor 2.4. Domestic wiring: Types of AC supply, Concealed and conduit wiring, Power rating of domestic appliances, fitting and fixtures, Sample example of one room electrification, Staircase wiring and godown wiring, electrical unit consumption and billing, Basic

		concept of energy audit 2.5. Electrical Safety: Fuse, MCB, ELCB, RCCB, Need of Earthing, First aid against electrical shock
Unit– III Electronics and Instrumentation	3a. Explain working of diode, transistor and SCR. 3b. Interpret block diagram of battery charger, inverter and UPS. 3c. Explain working principle of different types of electrical transducers. 3d. Describe the procedure of measuring electrical parameters using given digital instruments/CRO.	3.1 Basic construction, characteristics: Diode, NPN and PNP Transistor, SCR 3.2 Applications of transistor: Common base amplifier 3.3 Basic block diagram of battery charger, inverter and UPS (ON line/OFF line) 3.4 Block diagram of instrumentation system , Transducers: Basic understanding of transducer, LDR, Thermistor, Thermocouple, LVDT and strain gauge 3.5 Meters: Multi meter, Clamp-on meter, Digital energy meter 3.6 Use of Cathode Ray Oscilloscope (CRO)
Unit– IV Electrical Machines	4a. Classify electrical machines. 4b. Describe the construction of DC motor and generator. 4c. Explain working principle of transformer. 4d. Enlist applications of various electrical machines. 4e. Explain the use of DG set as emergency supply.	4.1 Types of electrical machines: Static and Rotating, AC and DC. 4.2 Basic construction and applications of DC machines: DC motor and generator. 4.3 Basic construction and principle of working: Transformer ,Auto transformer 4.4 Basic construction and applications of AC machines: , Single phase and three phase induction motor, Alternator 4.5 Construction and applications of BLDC motor 4.6 Use of DG set as emergency supply
Unit– V Green Electrical Energy	5a. Justify the need of green energy. 5b. Classify sources of green energy. 5c. Interpret block diagram of solar power plant. 5d. Interpret block diagram of wind power plant.	5.1 Need of green energy 5.2 Classification of green energy 5.3 Solar energy: PV cell, Panel and Arrays, Block diagram of solar power system 5.4 Wind energy: Block diagram of wind power system

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Tutorial Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	DC circuits	04	Not Applicable			
II	AC circuits and wiring	06				
III	Electronics and Instrumentation	06				
IV	Electrical Machines	08				
V	Green Electrical Energy	04				
Total		**28**				

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

Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should 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 specification of some electrical and electronic components.
b) Calculate total installed electrical load of any premises.
c) Undertake a market survey of different semiconductor components.
d) Prepare a chart for different types of electrical machines and their applications.
e) Give seminar on innovation in renewable energy sources.

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 on how to address issues on environment and sustainability.
g) Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (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 microproject 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) **Half wave and Full wave rectifier:** Design and assemble half wave and full wave rectifier using diodes.
b) **Extension board:** Prepare Extension board few sockets and switches.
c) **Electricity bill:** Calculate power consumption of your home and check your energy bill.
d) **Market Survey**: Prepare budget for making a trainer kit for demonstrating characteristics of electronics components.
e) **Working Model making for wind /solar power plant**: Search on internet video/animation preferably dynamic animation which demonstrates the parts and working of a solar and wind power system and prepare a report.
f) **Solar/Wind power generation in India:** Prepare a report on current installed capacity of RES with emphasis on solar
g) **Electronic waste**: Compile a report of handling electronic waste with figures, tables and comparative charts and strategies used/suggested.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Basic Electronics and Linear Circuits	Bhargava N.N., Kulshreshtha D.C. and Gupta S.C.	McGraw Hill Education, New Delhi, ISBN: 9780074519653
2	A text book of Electrical Technology-Vol.1	Theraja B. L. Theraja A.K.	S. Chand Publication ISBN: 9788121924375
3	A text book of Electrical Technology-Vol.2	Theraja B. L. Theraja A.K.	S.Chand Publication
4	A text book of Electrical Technology -Vol.4	Theraja B. L. Theraja A.K.	S.Chand Publication
5	A Course in Electrical and Electronic Measurements	Sawhney A. K.	Dhanpat Rai & Co.

S. No.	Title of Book	Author	Publication with place, year and ISBN
	and Instrumentation		
6	Non-Conventional Energy Sources	Rai G. D.	Khanna Publications ISBN:978-8174090737

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.iitm.ac.in
b) https://ndl.iitkgp.ac.in
c) www.electronicsforu.com
d) www.electrical4u.com
e) www.vlab.co.in

15. PO-COMPETENCY-CO MAPPING

Semester I & II	Basics of Electrical and Electronic Engineering (Course Code: 4300014)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation &Testing	PO 5 Engineering practices for society, sustain-ability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Apply the basic principles of electrical and electronics engineering in relevant engineering discipline applications.						
Course Outcomes CO a) Apply fundamentals of DC circuits and batteries in relevant engineering discipline.	3	1	1	3	-	-	2
CO b) Apply basic fundamental of AC circuits in relevant engineering discipline.	3	2	2	3	-	-	2
CO c) Use electrical and electronics instruments for measuring various parameters.	3	2	2	3	-	-	2
CO d) Distinguish electrical machines with relevant application.	3	1	1	2	-	-	2
CO e) Classify green energy sources with emphasis on working of solar and wind power plant.	3	-	-	2	3	-	2

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

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