GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester -IV

Course Title: Fundamentals of Electrical and Electronics Engineering
(Course Code: 4345801)

Diploma programmes in which this course is offered	Semester in which offered
Printing Technology	4th semester

1. RATIONALE

Diploma engineers have to deal with electrical and electronics engineering principles and applications in printing and allied fields. It is therefore necessary for them to apply the principles of electrical and electronics engineering. This course will make them conversant with electrical / electronic engineering aspects of different printing engineering-based processes in industries.

2. COMPETENCY

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

- **To know basic principles of electrical engineering in different 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:

1. Apply basics/ fundamentals of AC and DC circuits in real life application.
2. Describe operating principles and application of static and rotating machines.
3. To attend normal electrical faults and use electrical tools and instruments for normal application effectively.
4. To study the basic principles of illumination and its measurement
5. Demonstrate the function of various electronic devices.

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	30*	70	25	25	150

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of Cos, and the remaining 20 marks is the average of 2 tests to be taken during the semester for 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

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the* ***PrOs*** *marked* ***'*'*** *(in approx. Hrs column) 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	Verify Ohm's Law	I	02*
2	Measure equivalent resistance in (a) Series Resistance (b) Parallel Resistance.	I	02*
3	Determine relationship between line value and phase value in star/delta connection.	I	02*
4	Identify different parts of DC machine and write function of each part.	II	02*
5	Demonstrate three-point DC motor starter and working of each part.	II	02
6	Determination turns ratio of single phase transformer.	II	02
7	Identify the faults in the given electric motor.	II	02*
8	Identify the cables and fuses along with their specification.	III	02*
9	Draw, connect and verify staircase wiring.	III	02
10	To measure voltage, current and power in given single phase circuit connected to resistive load.	III	02*
11	Demonstrate connection of fuse, MCB and ELCB for given application.	III	02
12	Identify the different lighting accessories required for various types of lamps.	VI	02
13	Identify the different lighting accessories required for various types of lamp fittings.	VI	02*
14	To identify various electronic components with its specification and draw symbol	V	02*
15	Test characteristics of PN junction diode.	V	02*
16	To study the diode application of full wave and half wave rectifier.	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

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
3	Follow safe practices.	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 source, Dual channel (0-30 V, 0-2 A, digital display)	1,2,3
2	Three phase variance : 20A, Output 0-415V for Input of 415V 50Hz AC	4
3	Single phase resistive load bank : 230V, 2KWOR Lamp loads	3,7,11
4	DC Ammeter (0-2 A, Analog)	1,2,3
5	DC Voltmeter(0-30 V or 0-50 V, Analog)	1,2,3
6	Digital Multimeter: 51/2 digits resolutions with all basics measurement facility like DC Voltage: 200 mV ~ 1000 V, DC Current: 200 µA ~ 10 A, AC Voltage: True-RMS, 200 mV ~ 750 V, AC Current: True-RMS, 20 mA ~ 10 A, 2-Wire, 4-Wire Resistance: 200 Ω ~ 100 MΩ, Capacitance Measurement: 2 nF ~ 10000µF, Frequency Measurement: 20 Hz ~ 1 MHz etc., 0.015% DC Voltage Accuracy.	1,2,3,4,7,11
7	Rheostat (0-200 Ohm, 0-2 A, linear, slider type)	7,11
8	Bread board (2 Power, 2 ground rails, 2 circuit areas, contact points > 200, Volt > 15 V, Current > 1 A)	17,18,19
9	Three phase lamp loads suitable for making three phase star and delta connection	4
10	Resistors of various range	1,2,3,11
11	Ammeter:0-1A/0-5A/0-10A	4,7,11
12	Voltmeter:0-50V/0-150V/0-300V/0-500V	4,7,11
13	Wattmeter:0-1000W(5/10A,300/600V)	4,7,11
14	Regulated power supply: Dual DC , 0-30V/1A & 5V /1A with resolution of 10mV , 2mA	16,17,18
15	FTL, CFL, LED of different suitable rating.	13,14

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 competency.

a) Work as a leader/a team member.
b) Follow safety practices
c) Practice Good housekeeping
d) Follow ethical practices
e) Realize the importance of green energy.

The ADOs are best developed through 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 is formulated for the development of the Cos and competency. If required, more such higher-level Uos could be included by the course teacher to focus on the attainment of Cos and competency.

Unit	Unit Outcomes (Uos) (4 to 6 Uos at different levels)	Topics and Sub-topics
Unit – I Basic Electrical circuit	1a. Definitions of various electrical parameters related to DC supply. 1b. Define various electrical parameters related to AC supply. 1c. Explain three phase star and delta connection of three phase AC supply. 1d. Calculate energy bill	1.1 DC circuit parameters: Electric charge, Electric current, electric power, Electrical energy, EMF, Potential Difference, Resistance 1.2 ohm's law 1.3 Series and parallel connection of resistors. 1.4 AC circuit parameters: Cycles, Frequency, Time period, Amplitude, RMS value, Average value, Instantaneous value, peak value 1.5 Three phase star connection and delta connection 1.6 Relation of line voltage and phase voltage in three phase star connection and delta connection. 1.7 Work, power and Energy 1.8 Simple calculation of energy bill
Unit– II Electrical Machines	2a. Explain working principle, construction and application of DC generator. 2b. Explain working principle, construction and application of DC motor. 2c. Explain working principle,	2.1 Working principle, construction and application of DC generator. 2.2 Working principle, construction and application of DC motor. 2.3 Necessity of starter 2.4 Working principle, construction and application of transformer.

	construction and application of Transformer. 2d. Describe working of an autotransformer with sketches 2e. Explain working principle, construction and application of Induction motor.	2.5 Accessories of power transformer 2.6 Saving of copper in auto transformer. 2.7 Working principle, construction and application of three phase Induction motor. 2.8 Different types of three phase I.M. 2.9 Difference between single phase and three phase induction motor.
Unit - III Electrical Components, tools and instruments	3a. Explain specification of different types, materials and application of wires, cables and fuses. 3b. Use electrical tools and instruments for simple application.	3.1 Type, specification, material and application of wires, cables and fuses. 3.2 Types, construction, symbols, materials and application of various switches/ plug/ sockets. 3.3 Types, specification, materials of construction and application of various electrical tools. 3.4 Meters, multi meter, clip-on meter, voltmeter, ammeter, wattmeter Connection method and application.
Unit– IV Illumination	4a. Define various parameters related to illumination. 4b. Concept of direct and indirect illumination. 4c. Explain the laws of illumination.	4.1 Production of light 4.2 Define : Luminous flux, Luminous intensity, Solid angle and plane angle 4.3 Laws of illumination 4.4 Direct and indirect illumination system 4.5 Different light sources and reflections.
Unit– V Basic electronics components and circuits.	5a. Define Semiconductor. 5b. Describe types of semiconductor material. 5c. Compare conductor, insulator and semiconductor material. 5d. Draw the symbol of various semiconductor components. 5e. Describe working of the Photo diode, photo transistor, LDR, Photovoltaic Cell and Light Emitting Diode (LED) with symbols.	5.1 Brief introduction to semiconductor 5.2 Intrinsic and Extrinsic type semiconductors material 5.3 Composition of conductor, semiconductor and insulator 5.4 Describe working of the Photo diode, photo transistor, LDR, Photovoltaic Cell and Light Emitting Diode (LED) with symbols 5.5 Symbol of basic electronic components: PN junction diode, Zener diode, LED, Photo diode, Photo transistor, SCR, MOSFET, IGBT, DIAC, TRIAC 5.6 Application of different semiconductor devices.

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	**Basic electrical circuit**	6	4	4	2	10
II	**Electrical Machines**	10	8	8	6	22
III	**Electrical Components, tools and instruments**	4	4	4	4	12
IV	**Illumination**	3	3	4	3	10
V	**Basic electronics components and circuits.**	5	4	6	6	16
Total		**28**	**23**	**26**	**21**	**70**

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

Note*: This specification table provides general guidelines to assist students in 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 vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

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

a) Prepare journals based on practical performed in laboratory
b) Give seminar on relevant topic
c) Undertake micro projects
d) Market survey for innovative ideas
e) Prepare a chart on different types of semiconductor devices.
f) Prepare a chart on different types of electrical tools and components.

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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/subtopics.
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 assessedusing 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 the environment and sustainability.

g) Many electronics projects can be made using semiconductor and optoelectronic devices which are covered in syllabus, so encourage students to make such projects

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at 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 a dated work diary consisting of individual contributions 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) Make demonstrable models of various types of resistors, capacitors, inductors, their types, application based on types and rating etc.
b) Make charts to visualize parts and construction of different electrical machines.
c) Make demonstrable models for the various types of plug, sockets, switches, wires and cables.
d) Prepare chart of generation of alternating voltage.
e) Build circuit of half wave rectifier without filter.
f) Build circuit of full wave rectifier without filter.
g) Prepare chart of various electronic devices.
h) Build a basic circuit on bread board/PCB using electronic devices.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with the place, year, and ISBN
1	Electrical Technology Vol-1	Theraja, B. L.	S. Chand & Co. Ltd., 23 edition or latest edition, ISBN-10: 8121924405
2	Basic Electrical Engineering	Mehta V. K.	S. Chand & Company (PVT) LTD., 1988 or Latest edition, ISBN: 9788121908719
3	Fundamentals of Electrical Engineering and Electronics	S.K. Sahdev	Dhanpatrai& Co., New Delhi Latest edition(ISBN: 978877002027)

S. No.	Title of Book	Author	Publication with the place, year, and ISBN
4	Basic Electrical and Electronics Engineering	Ravish. R. Singh	Tata McGraw Hill EducationPvt.Ltd., New Delhi 2018 edition or Latest edition (ISBN-978007026092)
5	A textbook of Electrical Technology Volume-II	B. L. Theraja& A.K. Theraja	S. Chand and Co., New Delhi, 23 edition or Latest edition (ISBN : 9788121924405)
6	Electrical Machines	S.K.Bhattacharya M	McGraw Hill Education. New Delhi ISBN:9789332902855
7	A Course In ElectricalAndElectronicMeasurementsAndInstrumentation	Sawhney, A K	S.Chand Publication, New Delhi 2011 or latest
8	Utilization of electric power and electric traction	J B Gupta	S.K. Kataria& Sons (ISBN13: 9789350142226)

14. SOFTWARE/LEARNING WEBSITES

a. www.nptel.com/iitm/
b. www.howstuffworks.com
c. www.vlab.com
d. https://electrical4u.in/dc-machines/
e. https://lectures.gtu.ac.in/
f. https://www.electrical4u.com/electrical-engineering-articles/transformer/
g. **https://www.electronics-tutorials.ws/**

15. PO-COMPETENCY-CO MAPPING

Semester IV	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Course Code: 4345801)								
	POs								
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environme	PO 6 Project Management	PO 7 Life-long learning	PSO 1 Design and develop the product and process for the need of the industries and society	PSO 2 effectiveness for the various pre-press, press and post press process involved in printing to meet the industries requirement

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Competency	**To know basic principles of electrical engineering in different applications**									
Course Outcomes										
a) Apply basics/ fundamentals of AC and DC circuits in real life application	3	1	1				1	-	-	
b) Describe operating principles and application of static and rotating machine	3	1		2	1		-	-	-	
c) To attend normal electrical faults and use electrical tools and instruments for normal application effectively	3			2			-	-	-	
d) To study the basic principles of illumination and its measurements	3			2	1		-	-	-	

e) Demonstrate the function of various electronic devices.	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

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
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