GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Fundamentals of Electricals and Electronics
(Course Code: 4300018)

Diploma Programme in which this course is offered	Semester in which offered
Computer	**First Semester**

1. RATIONALE

The engineering technologists (i.e. engineering diploma holders) have to use/maintain various types of equipment which are electronically operated and controlled. For using/maintaining such equipment, the fundamental principles of electronics and electrical are to be applied in many situations to arrive at the probable solutions to many of the broadly defined problems which they will face during their career as technologists. Therefore, the knowledge about the functions of various basic electronics devices and the associated circuits including the associated practical skills acquired through the laboratory will help the student when s/he will be working with electronically controlled/operated equipment or electronic circuits. This course is therefore so designed that the students will be able to use/apply the principles of basic electronics as well as electrical as and when required.

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 principles of basic electrical and electronics in various engineering applications .**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a. Differentiate active and passive components and test them.
b. Identify various types of diodes and their applications.
c. Apply transistors in electronics circuits.
d. Demonstrate various electronic hardware components like PCB, ICs, cables and connectors.
e. Dispose electronic waste safely.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (CI+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
CI	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: CI-Class Room Instructions; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map provides the student an overview of the flow and linkages of the various types of learning outcomes to be attained by the student in all domains of learning leading to the industry identified competency depicted at the centre of this map.

6. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the subcomponents of the COs. Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO. These PrOs need to be attained at least at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1.	Study of various analog electronics Terminology and symbols	I	04
2.	To Study and Verify Ohm's Law	I	02
3.	Calculate resultant resistor value for series And parallel connection of resistors.	I	04
4.	Test VI characteristic of PN junction diode.	II	02
5.	Study Zener voltage regulator for the Given voltage.	II	02

6.	Build/test half wave rectifier.	II	02
7.	Build/test full wave rectifier using two diodes.	II	02
8.	Build/test full wave bridge rectifier using Four diodes.	II	02
9.	Test I/O Characteristics for CE Configuration	III	02
10.	Identify and study different types of cables.	IV	02
11.	Identify and study different types of connectors.	IV	02
12.	Demonstrate various methods of handling Electronic waste.	V	02
	Total		**28**

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.

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**

7. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

Sr.	Equipment Name with Broad Specifications	PrO.

No.		No.
1.	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	2-7
2.	Cathode Ray Oscilloscope Dual Trace 20Mhz, 1MegaΩ Input Impedance	2-7, 8-10
3.	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	2-7, 8-10
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 MΛ) , Capacitance and Temperature measurement	All
5.	Electronic Workbench : Bread Board 840 -1000 contact points : Positive and Negative power rails on opposite sides of the board , 0-30 V , 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO 0-30MHz , Digital Multimeter.	All

8. 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 competency.

a. Work as a leader/a team member.
b. Follow ethical practices.
c. Practice environmental friendly methods and processes. (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.

9. UNDERPINNING THEORY

The major Underpinning Theory is formulated as given below and only higher level UOs of Revised Bloom's taxonomy are mentioned for development of the COs and competency in the students by the teachers. (Higher level UOs automatically include lower level UOs in them). 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 Application level)	Topics and Sub-topics
Unit-I **Basic of Electrical Engineering**	a. Explain Electric current and voltage. b. Explain Electrical circuits and elements: Resistor, inductor, capacitor. c. Calculate Voltage and current using Kirchoffs' laws d. Differentiate active and passive components. e. Differentiate between various types of signals and signal parameters	1. Definition of current and voltage, units of current and voltage, Ohm's law, symbol and relation. 2. Characteristics of electrical circuit, resistor in series and parallel, inductor, capacitor 3. Kirchoffs' current and voltage law 4. Active components(Voltage source and current source), Passive components(Resistor, inductor, capacitor.) 5. Sinusoidal Signal, Triangular wave, square wave, sawtooth wave, amplitude, frequency, wave length, time period.
Unit – II **Diode theory and Rectifiers**	2a. Explain atomic structure and conductivity 2b. Explain diode theory 2c. Distinguish various diodes 2d. Designing various rectifier circuits. 2e. Justify the application of Diode.	1. Structure of atom, valence electron, conductor, semiconductor, insulator 2. Doping, Intrinsic semiconductor, extrinsic semiconductor, P-type and N-type semiconductor, majority charge carrier, minority charge carrier, P-N junction, Depletion layer, knee voltage, forward bias, reverse bias 3. Special diodes: LED, Photodiode,zener diode, tunnel diode, LASER diode and Power diode 4. Types of Rectifiers: Half Wave, Full Wave Rectifier (bridge and center tapped): circuit operation I/O waveforms for voltage and current 5. Zener diode as a voltage regulator

Unit – III Transistors	a. Distinguish the specification of the given type of transistors b. Differentiate the performance of the specified transistor with sketches. c. Interpret with sketches the performance of the CE Configuration. d. Justify the application of the transistor circuit.	1. Types of transistors: PNP, NPN 2. Working of transistors. 3. Transistor configurations(CE): circuit diagram, input and output characteristics. Different points of characteristics (Cut-off, Active and Saturation), input resistance, output resistance, current gain. 4. Transistor as a switch.
Unit– IV Electronic Hardware	a. Identify ICs b. Explain PCB types and manufacturing c. Introduce Electronic components manufacturing Hierarchy d. Explain logic families e. Identify different types of Cables and connectors	1. Definition, construction, types, example. 2. PCB layout, types, single layer, multi layer, manufacturing of PCB 3. SSI, MSI, LSI, VLSI (Introduction to various technology) 4. RTL, DTL, TTL, CMOS, Fan in, Fan out(Building components, No. of gates supported) 5. Twisted pair, Coaxial cable, fibre optic cable, RJ45 connector, BNC.
Unit– V Handling Electronic Waste	a. Justify the need of understanding electronic waste b. Establish the relationship of sustainability and electronic waste. c. Suggest methods of handling electronic waste with examples. d. Suggest methods to dispose electronic waste	1. Concept of electronic waste. 2. Sustainability and electronic waste 3. Methods to handle electronic waste 4. Disposal of electronic waste

Note: *The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

10. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Basic of Electrical Engineering	08	4	7	7	18
2	Diode theory and rectifiers	10	5	7	8	20

3	Transistors	12	4	6	5	15
4	Electronic Hardware	08	2	5	5	12
5	Handling Electronic Waste	04	1	2	2	5
Total		**42**	**16**	**27**	**27**	**70**

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 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 from above table.

11. 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 conduct following activities in groups and prepare small reports (of 1 to 5 pages for each activity). 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 charts/display boards of some electronic devices with their specification.
b. Undertake mini/micro-projects in teams/individual basis
c. Give seminar on any relevant topic.
d. Undertake a market survey of various types of hardware components.
e. Prepare showcase portfolios.

12. 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. 'CI" in section No. 4means 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.11, 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 using the knowledge of this course
g. Guide students for using data manuals.

13. 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 a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total work load on each student due to the micro-project should be about **16 (sixteen)** student engagement hours (i.e. about one hour per week) during the course. The students ought to submit micro-project by the end of the semester (so that they develop the industry oriented COs).

A suggestive list of micro-projects is given here. This should relate highly with competency of the course 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.

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

14. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
	Electronic Devices and Circuit: An Introduction	Mottershead, Allen	Goodyear Publishing Co. ,New Delhi, ISBN : 9780876202654
	Principles of Electronics	V. K. Mehta (Text book)	S. Chand
	Electronic Principles	A .P. Malvino(Text book)	TMH Edition
	The Art of Electronics	Horowitz, Paul; Hill, Winfield	Cambridge University Press, New Delhi 2015 ISBN : 9780521689175
	Basic Electronic Engineering	Baru, V.; Kaduskar, R.; Gaikwad S.T.	Dreamtech Press, New Delhi,2015 ISBN: 9789350040126
6.	Fundamentals of Electronic Devices and Circuits	Bell, David	Oxford University Press New Delhi, 2015, ISBN : 9780195425239
7.	Electronic Devices and Circuit	Maini, Anil K.	Wiley India, New Delhi, ISBN : 9788126518951
8.	Transistor Selector Handbook	-	Tower's International Foulsham, London, 1974, ISBN: 9780572008888

15. SUGGESTED LEARNING WEBSITES

a. www.datasheetcafe.com
b. www.williamson-labs.com
c. www.learnerstv.com
d. www.cadsoft.io
e. www.nptel.iitm.ac.in
f. www.khanacademy
g. www.vlab.co.in

16. PO-COMPETENCY-CO MAPPING

Semester II	Basic Electronics (Course Code: ………………….)									
	POs and PSOs									
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 & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**	**PSO 1**	**PSO 2**	**PSO 3 (If needed)**
Competency *Apply principles of basic electrical and electronics in various engineering applications*										
Course Outcomes CO1 Differentiate active and passive components and test them	2	1	2	2	1					
CO 2 Identify various types of diodes and their applications	2	2	1	1	1	1				

CO 3 Apply transistors in electronics circuits	1	2	1	1	1	1				
CO 4 Demonstrate various electronic hardware components like PCB, ICs, cables and connectors	2	1	1	2	1	2				
CO 5. Dispose electronic waste safely	1	1	1	1	2	1				

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

17. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri S. B. Prasad	Government Polytechnic Gandhinagar	9879237924	sbprasad011@gmail.com
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NITTTR Resource Persons

Sr. No.	Name and Designation	Department	Contact No.	Email