GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Electrical & Electronic Workshop
(Course Code: C4320302)

Diploma programmer in which this course is offered	Semester in which offered
Biomedical Engineering	Second

1. RATIONALE

In this subject, students will learn how to handle various general-purpose tools and measuring instruments to build and test and troubleshoot electronic circuit. They will learn how to test various electronics components using appropriate measuring equipment's. They will practices on soldering and de-soldering electronic components on plastic circuit board (PCB). Students will learn how to design schematic layout of miniature electronic circuit using openly available PCB designing software. Students will attain skills to assemble and test electronics circuit on PCB which will be benefited them to execute micro project in each subject in subsequent semester and major project in final year. This course will help student to develop skills regarding safety aspects of individual while working with electrical and electronics gazettes.

2. COMPETENCY

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

Build, Test and Troubleshoot electronic circuits on Plastic Circuit Board (PCB) using relevant tools with appropriate safety measures.

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) Test various electronic components by using appropriate measuring instruments.
b) Assemble electronic circuit on bread board or general purpose PCB using appropriate tools.
c) Create schematic & layout on Plastic Circuit Board (PCB) using PCB design Software.
d) Build and Test miniature Electronic Circuit as a minor Project.
e) Analyze the physiological effect of electric current on human body.

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	

0	0	2	1	00	00	25*	25	50

(*): For this practical only course, 25 marks under the practical CA have 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

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	Identify various electrical and electronic component symbols.	I	02*
2	Identify various types of Resistor, Capacitor and Inductor, Relay, Diode, Zener diode, LED, Photo diode, BJT, Photo transistor, LDR, Solar cell, Photocell, Opto-coupler	I	02*
3	Operate CRO, DSO and function generator	I	02*
4	Use of multimeter for measurement of voltage and current in basic electronic circuits.	I	02*
5	Testing of Diode, transistor and capacitor	I	02*
6	Measure voltage, current and power of in step-down and center tap transformer transformer.	I	02
7	Use of relay for basic switching circuits.	I	02
8	Use different types of electrical and electronics workshop tools.	I	04
9	Download and interpret Data sheets with respect to Specifications, package and applications of following components from using internet (For any five component in laboratory): (a) Diodes IN4001 to 1N4007, IN4148, 2N5402, 2N5408,BY127 (b) Zener Diode - 5V6 (c) Photo diode - BPW10	I	04*

	(d) LED - & Multi colored LED (e) Seven segment LED (f) Transistors BC107, BC177, BC547/548, (g) Transistors SL100, SK100, AC127/128, BF194, TIP122 (h) IC 78XX, 79XX and LM317		
10	Create schematic and layout of given electronic circuit using any PCB design software and fabricate complete PCB (with Drill) (Circuits given as a guideline only): (a) +/-12V Regulated Power supply Using IC 7812 , 7912 & 317 (b) Light operated Relay (c) TV remote checker using transistor ,IR photo diode, red LED (d) Touch switch using transistor (e) Door safety using Reed and magnet (f) Water level alarm using single transistor (g) Opaque Object sensing alarm using LDR, transistor & Buzzer (h) Infrared Motion detector. (i) AC to DC 12V LED Strip Driver Circuit (j) Street Light Circuit using LDR (k) Automatic Washroom Light Switch (l) Auto Intensity Control of LED Lights (m) Basic Logic Gates using NAND Gate (n) Basic Logic Gates using NOR Gate (o) Half Adder and Full Adder Circuit (p) JK flip flop and SR flip flop circuit (q) Multiplexer circuit 8x1	II	10
11	Trace electronic circuit from the given PCB layout or Soldered PCB	III	08*
12	**Mini project:** 1. For basic/Simple real time electronic applications, Select electronics circuit, 2. Develop PCB layout using any PCB designing software 3. Build it on PCB (Which must be self prepared) 4. Test/Debug/Run it. 5. Prepare small Project report describing above procedure.	IV	12
13	Make chart or poster on patient safety.	V	02*
	Minimum Practical Hours		**56**

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. Utmost *Care must be taken while students are doing experiments related to electrical appliances. All safety precautions must be observed while dealing with 230 V AC. Also while doing soldering practices student must avoid the direct contact of tip of soldering iron on body or on table/platform. Teacher has to discuss about latest type of electronics components used in consumer electronics gazettes.*
iii. For more facilitate and familiar with building electronics circuit every student must purchase basic workshop tools like soldering iron, de soldering pump, bread board and good quality Digital Multi-meter.
iv. For better soldering practices, in a group maximum four student should allowed.
v. Miniature project as stated in unit 5 must be made individually by student to develop practical skill related to goal of this subject.
vi. Interested student can assemble the electronic projects which are ready made available as discrete component and PCB in commercial market.
vii. Every institute must possess different variety of latest electronics components, measuring instruments and consumable materials to give enough justice to teach this subject as suggested in Unit 1 of underpinning theory section.
viii. Students are advised to search more knowledge of typical components on U tube or internet where so many demonstration videos are available. Many mobile android apps are available related to electronics components, explore them.

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 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**

6. Major Equipments , Tools and Consumables 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	Function generator, CRO/DSO	3

2	Demonstration chart/Kits for different category of electronic component	1,2
3	Variable DC power supply 0- 30V, 2A, Short Circuit protection, display for voltage and current.	2.3.10.12
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 M) , Capacitance.	4,5,7
5	Discrete Component Trainer/ Analog component Trainer: 2mm patch cords in interconnecting components, Collection of utilities like fixed and variable D.C. supplies, electrical Components like, LDR, Transistor, Photo diode, IC 78XX, IC 79XX, LM315, resistors, capacitors, inductors, LED's, Built in variable DC supply dual ± 0 to 15V/ 500mA, fixed DC power supply, ± 12V / 500 mA, fixed DC power supply +5V/500mA, Built in AC supply.	2,3,10,12
6	Variable AC output transformer (VARIAC)	6
7	Soldering Iron, De-soldering pump, Soldering and De-soldering Station with temperature controller, Hot air soldering and soldering station, Bread boards , General Purpose PCB, PCB Boards	15

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 safety practices while using electrical, electronic instruments and tools.
c) Realize importance of electric shock hazards.

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	Unit Outcomes (UOs)	Topics and Sub-topics
Unit-I	1a. Identify and	1.1 Resistors: General-purpose

Electronics Components and Measuring Instruments	Demonstrate terminals of different Electronic components 1b. Test different Electronic components 1c. Use of measuring instruments and various electronics workshop Tools for building electronics circuit 1d. Interpretation of Data sheets of Electronics Component 1f. Select appropriate component from given specifications.	resistors, Power resistors, Wirewound resistors, Thick film resistors, Surface-mount resistors, ceramic resistor, Axial resistors, Precision resistors, Variable resistors, Thermistor, resistor array, standard resistor values. 1.2 Inductors: Iron core, Ferrite core, Toroidal core inductor, Variable with slug, Air core. 1.3 Capacitors: cylindrical capacitor, disc capacitor, ceramic capacitor, capacitor array, electrolytic capacitor, tantalum capacitors 1.4 Transformer: Step Up/Step down Transformer, Variac, 12-0-12, 6-0-6 center tap transformer. 1.5 Electronic components: Relay, Diode, Zener diode, LED, Photo diode, BJT, Photo transistor, LDR, Solar cell, Photocell, Opto-coupler. Thermister, & 7 Segment display 1.6 Testing of Resistor, Capacitor, Diode and Transistor, Inductor using multimeter. 1.7 Electronic Workshop Tools: Bread board, Solder iron, solder-stand, solder-wire, flux, Cutter, plier, screwdriver set, wire stripper, de -solder pump, De-solder wick, drilling machine. 1.8 Manufacturer's Datasheet of: - Diodes IN4001 to 07, IN4148; 2N5402, 2N5408, BY127 – Zener Diode, Photo diode, LED, Seven segment LED. Transistors BC107, BC177, BC547/548, SL100, SK100, AC127/128, BF194, TIP122, Photo transistor. Voltage regulator IC78XX,

		79XX. LM 317 1.9 Miscellaneous Components: General purpose mechanical relay, SPST/DPDT Switch, Condenser Microphone ,Magnetic Buzzers, Piezzo buzzer, Loudspeaker ,Miniature speaker, Crystals, Heat sink 1.10 Measuring Instruments: Analog Multimeter, Digital Multimeter, CRO, DSO, Function Generator, wattmeter, LCR-Q meter
Unit– II **Build Electronics Circuit**	2a. Implement Electronic circuit on breadboard 2b. Implement Electronic circuit on General purpose Board	2.1 Soldering of Electronics Components on General Purpose PCB with observing all safety precautions. 2.2 Implement miniature circuit on bread boards and test it. 2.3 Implement miniature circuit on General Purpose PCB board and test it.
Unit-III **PCB Design**	3a. Create PCB layout manually. 3b. Create schematic layout of Printed Circuit Board (PCB) using open source PCB design software. 3c. Trace circuit from given PCB layout on the PCB.	3.1 PCB layout. 3.2 PCB design software. 3.3 PCB layout - Component side and copper side. 3.4 Tracing for PCB Fabrication. 3.5 Soldering - types - selection of materials, soldering practice in connectors and general purpose PCB.
Unit-IV **Mini Project**	5a. Build Electronic Circuit on the PCB. 5b. Test, Troubleshoot and Run the Project.	4.1 Fabrication of PCB for a selected electronic circuit. 4.2 Selection of component & testing. 4.3 Component mounting & Soldering. 4.4 Testing and trouble shooting of circuit. 4.5 Prepare report in proper format.
Unit-V **Patient Safety and Shock Hazards**	4a. Describe the physiological effect of electrical current	5.1 Generalized model of an accident 5.2 various physiological effect on

	4b. Explain shock hazards from medical equipment 4c. Explain the different method of accident prevention	human body 5.3 Gross shock, Leakage current , and types of leakage current 5.4 Shock hazards in medical equipment 5.5 Method of Accident prevention: Earthling, Double insulation, Ground fault Circuit Interrupter, Isolation of patient connected parts

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	**Electronics Components and Measuring Instruments**	**Not Applicable**				
II	**Build Electronics Circuit**					
III	**PCB Design**					
IV	**Mini Project**					
V	**Patient Safety and Shock Hazards**					

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:

a) Seminar on specification of some electrical and electronic components/ Gazettes.
b) Poster presentation on advance electronics component.
c) Give seminar on any PCB designing software.
d) Visit any factory where student can see assembly line or PCB fabrication.

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 for reading data sheets.
h) Motivate student to install and use different open source PCB designing software.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Encyclopedia of Electronic Components Volume 1 Resistors, Capacitors, Inductors, Switches, Encoders, Relays, Transistors.	Charles Platt	O'Reilly, United States of America-2013. ISBN: 978-1-449-33389-8
2	Printed Circuit Boards: Design and Technology	Bossart	TMH, latest edition ISBN-10 9907414700 : ISBN-13 9907414704-009 :
3	Printed Circuit Boards	R S KHANDPUR	Tata Mcgraw Hill ISBN : 9780070588141
4	Build Your Own Printed Circuit Board	Al Williams	Mc Graw Hill, latest edition ISBN-10 9909947999 : ISBN-13 9909947999-009 :
5	Making Printed Circuit Boards	Jan Axelsen	Mc Graw Hill, atest
6	PCB Design: Printed Circuit Board.	Michael Dsouza	Kindle Edition
7	Fundamental of Biomedical Instrumentation	Dr. O. N. Pandey	S. K. Katariya & Sons
8	Handbook of Biomedical Instrumentation	R. S. Khandpur	McGraw Hill Education

13. SOFTWARE/LEARNING WEBSITES

- https://shaileshdhoriyani.webs.com/apps/blog (for basic electronic components
- https://www.electrical4u.com/types-of-resistor (for Resistor)
- https://www.electronics-tutorials.ws/resistor/res_1.html (for Resistor)
- https://www.electronicshub.org/types-of-diodes/ (for Diodes)
- https://www.electronicshub.org/design-of-basic-logic-gates-using-nand-gate/
- https://circuitdigest.com/electronic-circuits
- https://www.circuitstoday.com/simple-electronics-projects-and-circuits
- https://circuiteasy.com/
- https://nptel.ac.in (for online courses and video of all engineering branches)
- www.electronicsforu.com (for basic electronic projects and technical videos)
- https://www.vlab.co.in(Virtual Lab for all engineering branches)
- Fritzing – PCB Designing Open Source Software.
- KiCAD – PCB Designing Open Source Software.

14. PO-COMPETENCY-CO MAPPING

Semester II	**Electrical and Electronics Workshop**						
	POs						
Course Outcome	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimen-tation & Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
CO1-Test various electronic components by using appropriate measuring instruments.	3	2	3	3	-	-	3
CO2- Assemble electronic circuit on bread board or general purpose PCB using appropriate tools.	3	2	3	3	1	-	3
CO3-Create schematic & layout on Plastic Circuit Board (PCB) using PCB design Software.	2	3	3	3	2	-	3
CO4- Build and Test miniature Electronic Circuit as a minor Project.	3	3	3	3	2	3	3
CO5-Analyze the physiological effect of electric current on human body.	3	3	3	1	3	-	1

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

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Person

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