GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: **Fundamentals of Electronics**
(Course Code: 4311102)

Diploma programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	First
Power Electronics	Second

1. RATIONALE

The engineering diploma holders are required to use and maintain various types of electronically controlled equipment. The fundamental principles of electronics are to be applied in most of the situations to arrive at the probable solutions which is faced in the world of work, therefore the knowledge of the functions of various basic electronic devices and components and practical skills acquired through the laboratory experiments will help them, when they work with 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 typesof electronic 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:

- **Use principles of basic electronics to maintain various electronics circuits and equipment.**

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 basic active and passive electronic components.
b) Develop different types of rectifiers using PN junction diode.
c) Use special purpose diodes for different applications.
d) Analyze various transistor configurations.
e) Dispose electronic waste safely.

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	
4	0	2	5	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

The following practical outcomes (PrOs) 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	Use Digital Multimeter to measure basic electrical parameters likecurrent, voltage and resistance.	I	02*
2	Use CRO to measure electrical parameters of different types of signals obtain from Function generator.	I	02*
3	Measure resistance, capacitances and inductances of different typeof resistors, capacitors and inductors using LCR meter and verify it through color code and numerical code.	I	02*
4	Test the performance of LDR and measure the variation in resistancewith the change in light intensity.	I	02
5	Test the performance of PN junction diode and obtain forward Voltage drop and diode current.	II	02*
6	Build and test the half wave rectifier on a breadboard.	II	02
7	Build and test the output of the full wave center tap rectifier on abreadboard.	II	02
8	Build and test the full wave bridge rectifier on a breadboard.	II	02*
9	Test the performance of half and full wave rectifier with shunt capacitor filter.	II	02*
10	Test the performance of the zener diode and obtain the Zener breakdown (Reverse) voltage and current.	III	02
11	Build and test zener voltage regulator for the given regulated voltage.	III	02*
12	Test the performance of LED in series and shunt connection andmeasure the current and voltage in both the connections.	III	02
13	Test the performance of Photodiode and obtain reverse voltagedrop and diode current with change in light intensity.	III	02*
14	Test common emitter transistor configuration and obtain the valueof current gain and input impedance.	IV	02*
15	Test common base transistor configuration and obtain the value ofcurrent gain and input impedance.	IV	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
16	Test common collector transistor configuration and obtain thevalue of current gain and input impedance.	IV	02
17	Use transistor as switch.	IV	02*
18	Build and test common emitter amplifier and obtain the value of voltage gain for given input signal .	IV	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	Follow the procedure to complete the connections and take readings.	20
3	Follow safe practices measures.	10
4	Record observations as per guidelines.	15
5	Interpret the result and conclude the work.	35
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These 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	Dual variable DC power supply ,0- 30V, 2A, With Short circuit protection, separate displayfor voltage and current	4,5,6,7,8,9,10, 11,12,13,14, 15,16,17, 18
2	Cathode Ray Oscilloscope ,Dual Trace 20Mhz, 1MegaΩInput Impedance	2,5,6,7,8,9,13, 14,15,16, 17,18
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	2
4	Digital Multimeter : 3 1/2 digit display, 1999 count digital multimeter measures: V_{ac}, V_{dc} (600V max) , A_{dc}, A_{ac} (10 amp max) , Resistance (0 – 2 Mega Ohm) , with diode and transistor tester	1,4,5,6,7,8,9, 10,11,12,13, 14,15,16,17,18
5	LCR meter bench top or hand-held type, 3 1/2 digit LCD /LED	3

S. No.	Equipment Name with Broad Specifications	PrO.No.
	display,1999 count , Resistance 0-20 Mega Ohm , Capacitance 0-200 micro Farad , Inductance 0 – 20 Henry	
6	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 powersupply, Function Generator 0-2MHz, CRO 0-30MHz , DigitalMultimeter	1 to 17 & 18

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 ethical practices.
c) Practice environmentally friendly methods and processes.
d) Follow safety precautions.

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) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit – I **Electronic Components**	1a. Compare active and passive components. 1b. Explain the calculation of color coding technique for resistance calculation. 1c. Compare specifications of various types of capacitors. 1d. Differentiate various types of resistors, capacitors and Inductors on the basis of construction and working principle. 1e. Describe the applications ofgiven type of passive component.	1.1 Introduction to electronics, Brief History of electronic components, active and passive components 1.2 Resistors: Concept of resistors, specification of resistor, classification of resistors, fixed type and variable type resistors with applications, color coding ofresistors, Light dependent resistor (LDR) - symbol and working.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		1.3 Capacitors: Concept of capacitor,Classification of capacitors, capacitors specifications, fixed capacitor, specification and application of ceramic disk capacitor, polyester capacitor , mica capacitor ,aluminum electrolytic capacitor, tantalum capacitor, variable capacitor-application of air gang PVC gangand Trimmer capacitor – mica, Coding of capacitors using directly printed codes and color band system 1.4 Inductors: Faraday's laws of electromagnetic induction self-inductance, mutual inductance,inductor specifications, introduction to air core, iron core and ferrite core inductor, toroidal inductor, Color coding of inductors
Unit – II **PN junction diode and Rectifiers**	2a. Describe the characteristics ofPN junction diode. 2b. Compare performance of various types of rectifiers. 2c. Calculate ripple factor, ripple frequency , PIV and efficiencyof the given type of rectifier. 2d. Justify the selection of specifictype of rectifier for the given application. 2e. Discuss function of shunt capacitor and Pi – filter	2.1 PN Junction diode: P-type and N-type semiconductor, construction of PN junction diode, symbol, working and characteristics of PN junction diode, Forward voltage drops, reverse leakage current, power dissipation, breakdown voltage, Peak inverse voltage (PIV) 2.2 Rectifier: Need of rectifier, definition, types of rectifiers 2.3 half wave rectifier, full wave centre tap and bridge rectifier,output voltage, current, ripplevoltage, ripple factor, ripple frequency, PIV of a diode, transformer utilization factor, efficiency of half wave and fullwave rectifiers

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		2.4 Filters: Need and applications ofrectifier filters, types of filters: shunt capacitor & Pie filter
Unit– III **Special Purpose Diodes**	3a. Describe the working of the Zener voltage regulator circuit. 3b. List applications of the giventype of diode. 3c. Describe working principle ofLED.	3.1 Zener diode: -Symbol, construction, characteristics and application as a voltage regulator 3.2 Symbol, construction, and application of Varactor diode, Schottky barrier diode, Crystaldiode 3.3 Symbol, construction and application of Photodiode, LightEmitting Diode(LED) and Multi color LED
Unit– IV **Introduction toTransistors**	4a. Describe working principle of PNP and NPN transistors with the help of suitable sketch. 4b. Explain the operation of transistor for the given biasingbetween emitter base and collector. 4c. Sketch the Input- output characteristics curve and calculate the current gain forthe given transistor configuration. 4d. Explain function of transistor as switch in cut off and application of saturation region. 4e. Interpret transistor data-sheets	4.1 Transistor NPN and PNP symbol, construction, working, amplifyingaction, important specifications of transistor 4.2 Transistor Configuration and input output characteristics of NPN transistors in Common base(CB), Common emitter (CE) and Common collector (CC) configuration 4.3 Relation between current gain ofCB, CE and CC configuration, alpha, beta and gama of transistor 4.4 Transistor as switch in cutoff andsaturation region 4.5 Application of transistor as Common emitter amplifier 4.6 Interpret data sheets and choose transistor for given application based on polarity, material , Vcbo , Vceo , Icmax, hfe, Ft, Ptot (Power dissipation total) and package type(TO-3 , SMT etc.)

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit– V **Handling Electronic Waste**	5a. Justify the need of electronicwaste methods. 5b. Establish the relationship between sustainability andelectronic waste. 5c. Suggest methods of handling electronic waste with examples. 5d. Suggest methods to dispose electronic waste.	5.1 Concept of electronic waste. 5.2 Sustainability and electronic waste management 5.3 Methods to handle electronic waste 5.4 Strategies of electronic waste management in the small electronics Industries

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	Electronic Components	14	6	4	6	16
II	PN junction diodes and Rectifiers	14	4	8	10	22
III	Special purpose diodes	11	2	6	6	14
IV	Introduction to transistors	12	2	4	6	12
V	Handling Electronic Waste	5	1	3	2	6
Total		**56**	**15**	**25**	**30**	**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 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 a table and interpret the technical specification of various diodes and transistors using data sheet.
b) Prepare specifications of some electronic components.
c) Collect information and 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.
f) Undertake a survey of CPCB/GPCB authorized E-Waste handling agencies.
g) Undertake a visit to e-waste handling plant nearby and prepare a report.

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 finding proper active and passive components using datasheet manuals and websites for electronic application

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) **Diode:** Build a circuit on general purpose PCB or breadboard to obtain +12V unregulated DC power supply using full wave bridge rectifier and filter (Duration: 8-10 hours)
b) **Photodiode**: Build a interruption detector circuit to blink an LED using LDR, and prepare a mini project report. ((Duration: 6-8 hours)
c) **Transistor Amplifier**: a common emitter amplifier using transistor and prepare a mini project report. (Duration: 6-8 hours)
d) **Transistor Application:** Build a transistorized water level indicator and prepare a mini project report. (Duration: 6-8 hours)
e) **Special Purpose Diodes:** Build basic applications using any one or combination of special purpose diodes , and prepare a mini project report. (Duration: 6-8 hours)
f) **Electronic Waste**: Prepare a report of strategies regarding handling of electronic waste with figures, tables and comparative charts.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Basic Electronics and Linear Circuits	N.N. Bhargava , D.C. Kulshreshtha , S.C. Gupta	McGraw Hill Education, ISBN: 9781259006463
2	Electronic Devices and Circuit: An Introduction	Mottershead, Allen	Goodyear Publishing Co., New Delhi, ISBN : 9780876202654
3	The Art of Electronics	Horowitz, Paul; Hill, Winfield	Cambridge University Press, New Delhi, 2015, ISBN : 9780521689175
4	Basic Electronic Engineering	Baru, V., Kaduskar, R., Gaikwad S.T.	Dreamtech Press, New Delhi, 2015 ISBN: 9789350040126
5	Fundamentals of Electronic Devices and Circuits	Bell, David	Oxford University Press New Delhi, 2015, ISBN : 9780195425239
6	Electronic Devices and Circuit	Maini, Anil K.	Wiley India, New Delhi, ISBN : 9788126518951
7	Transistor Selector Handbook	TAB books	Tower's International Foulsham, London, 1974, ISBN: 9780572008888
8	Principles of Electronics	V.K.Metha, Rohit Mehta	S. Chand, New Delhi, 2014, ISBN: 978-8121924504
9	E-Waste: Management and Procurement of Environment	Suresh Kumar, JatindraKumar Pradhan	Authors press 2021, ASIN : B095PR6MVS
10	Solid and Liquid Waste Management Waste to Wealth	Rajaram Vasudevan, Siddiqui Faisal Zia , Agrawal Sanjeev	PHI Learning Pvt. Ltd. NewDelhi ISBN: 9788120352452

14. SOFTWARE/LEARNING WEBSITES

- www.datasheetcafe.com
- www.williamson-labs.com
- www.learnerstv.com
- www.cadsoft.io
- https://lectures.gtu.ac.in/listview.aspx?br=11&course=DI
- www.nptel.iitm.ac.in
- www.khanacademy
- www.youtube.com
- www.alldatasheet.com
- www.electronics-tutorials.ws
- www.instructables.com/Basic-Electronics
- www.makerspaces.com/basic-electronics

- https://robu.in/product-category/electronic-components/
- https://in.rsdelivers.com/campaigns/microsites/electronics?cm_mmc=IN-PPC-DS3A-_-google-_-0_IN_EN_Brand_RS+Components|Pure_BMM-_-RS_Components-_-%2Brs+%2Bcomponents&matchtype=b&kwd-296158955919&s_kwcid=AL!7457!3!360038397031!b!!g!!%2Brs%20%2Bcomponents&gclid=EAIaIQobChMIq9DAjuqb8gIVwRErCh2QaQvYEAAYASACEgKUgPD_BwE&gclsrc=aw.ds
- https://www.digikey.in/?utm_adgroup=General&utm_source=google&utm_medium=cpc&utm_campaign=EN_Competitor_Mouser_E&utm_term=mouser&productid=&gclid=EAIaIQobChMIg8Ktqeqb8gIV7xxyCh2cUwbYEAAYAiAAEgKsovD_Bw
- https://electronicscoach.com/category/basic-electronics

15. PO-COMPETENCY-CO MAPPING

Semester I	Fundamentals of Electronics (Course Code: 4311102)						
	POs						
Competency & Course Outcomes	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
Competency	**Use principles of basic electronics to maintain various electronics circuits and equipment**						
Course Outcomes CO a) Use basic active and passive electronic components.	3	2	1	3	-	2	1
CO b) Develop different types of rectifiers using PN junction diode.	3	1	2	2	1	1	-
CO c) Use special purpose diodes fordifferent applications	3	1	2	2	1	1	1
CO d) Analyze various transistor configurations	3	1	2	2	-	-	-
CO e) Dispose electronic waste safely.	3	1	1	2	3	1	1

*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

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