GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Electronics Devices & circuits
(Course Code: 1323202)

Diploma programme in which this course is offered	Semester in which offered
Information and Communication technology	Second

1. RATIONALE

Electrical, Electronic and communication, Information and communication technology and allied 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 devices and apply the knowledge to maintain the various types of 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:

To maintain various electronic circuits and it's 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) Use electronic devices for various applications
b) Test different amplifiers and oscillators.
c) Use different Thyristors for various applications.
d) Use integrated circuits for various applications
e) Build Regulated Power Supply for Green Technology

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	0	2	3	30	70	25*	25	150

(*): 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	Build and test voltage divider bias type amplifier	I	02*
2	To build relay driver using transistor as a switch	I	02
3	Obtain frequency response of single stage transistor amplifier.	II	02
4	Obtain frequency response of two stage RC-coupled amplifier.	II	02*
5	Test the effect of voltage series negative feedback on amplifier	II	02*
6	Build and test Hartley oscillator	II	02*
7	Build and test Colpitt oscillator	II	02
8	Build and test Crystal oscillator	II	02
9	obtain the characteristics of SCR	III	02*
10	obtain the characteristics of DIAC	III	02

11	obtain the characteristics of TRIAC	III	02*
12	Control AC power using TRIAC	III	02
13	Control DC power using SCR	III	02*
14	Use MOC 3041 /3083 Optocoupler and TRIAC for AC power control	III	02
15	Build and test inverting amplifier using Op-Amp IC-741	IV	02*
16	Build and test non-inverting amplifier using Op-Amp IC-741	IV	02
17	Build and test summing amplifier using Op-Amp IC-741	IV	02*
18	Build and test integrator using IC-741 Op-Am Op-Amp IC-741.	IV	02
19	Build and test differentiator using Op-Amp IC-741	IV	02*
20	Build and test comparator using Op-Amp IC-741	IV	02
21	Build and test monostable multivibrator using IC 555	IV	02
22	Build and test bistable multivibrator using IC 555	IV	02
23	Build and test astable multivibrator using IC 555	IV	02*
24	Measure voltage at various test points of SMPS and obtain its load and line regulation	V	02
25	Build fixed voltage regulator using 78xx and 79xx and measure the load and line regulation	V	02
26	Build variable voltage regulator using LM317 and measure the dropout voltage for the given voltage regulator.	V	02*
27	Build and test one mini project using basic electronic components and general purpose PCB.	I,II, III,IV,V	02*
	Minimum 13 Practical Exercises		**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. Care must be taken in assigning and assessing study report as it is a first year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.

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**

6. MAJOR EQUIPMENTS/ INSTRUMENTS 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.	Dual variable DC power supply, 0- 30V, 2A, With Short circuit protection, separate display for voltage and current.	1 to 15
2.	Cathode Ray Oscilloscope, Dual Trace 20 MHz, 1MΩ Input Impedance.	1, 3, 4, 7, 8, 9
3.	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	3,4,7, 8,9
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 MΩ) , with diode and transistor tester	1, 2, 5, 6, 12, 13, 14, 15

5.	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 power supply, Function Generator 0-2MHz, CRO 0-30MHz , Digital Multimeter	1, 7, 8, 10, 11, 12, 13,15

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 ethical practices.
c) Practice environment 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 **Transistor Biasing circuits**	1a. Explain biasing of amplifier and operating point. 1b. Describe the D.C. and A.C. Load Lines. 1c. Compare Biasing Methods. 1d. Explain Stability Factor with features. 1e. Describe Thermal Runaway and Thermal Stability. 1f. Select appropriate Heat Sink.	1.1 Biasing of Amplifier and Definition of Operating Point 1.2 **The Load Lines:** D.C. Load Line and A.C. Load Line. 1.3 **Stability Factor**: Definition and features. 1.4 Biasing Methods - fixed bias, collector to base bias and voltage divider bias **(without analysis)** 1.5 Thermal Runaway, Thermal Resistance & Thermal Stability. 1.6 Heat Sink , types and applications of heat sinks
Unit– II **Transistor applications**	2a. Define Amplifier Parameters. 2c. Explain Single Stage Amplifier. 2d. RC Coupling Techniques for cascading. 2e. Explain Frequency Response Two Stage RC Coupled Amplifier. 2f Compare negative and positive feedback in amplifier 2g. Describe types of negative feedback. 2h. Explain advantages and disadvantages of negative feedback in amplifiers in detail. 2i . Explain working of different type of oscillators. 2j Explain working of transistor as switch	2.1 Gain, Bandwidth and Gain Bandwidth product. 2.2 Frequency Response of Single Stage Amplifier. 2.3 RC Coupling Techniques for cascading 2.4 Frequency Response of Two Stage RC Coupled amplifier. 2.5 Negative feedback and positive feedback (only types , and block diagram without analysis) 2.6 Voltage series negative feedback. 2.7 List advantages and disadvantages

		of negative feedback on the parameter of amplifiers 2.8 The Barkhausen's criterion for oscillator 2.9 Hartley oscillators, Colpitt oscillator , Crystal oscillator 2.10 working of transistor as switch and relay driver
Unit-III Thyristors	3a.Describe constructional features and working of SCR, DIAC and TRIAC 3b.Draw the characteristics of SCR, DIAC,TRIAC,. 3c.Applications of SCR, DIAC and TRIAC for AC/DC power control	3.1 SCR: symbol ,construction, working, characteristics 3.2 Working of SCR using two transistor analogy. 3.3 Gate Triggering method of SCR. 3.4 Natural Commutation techniques of SCR. 3.5 Characteristics of DIAC and ,TRIAC, 3.6 Optocoupler TRIAC driver : MOC 3041 and MOC 3083 3.7 TRIAC applications as fan regulator and ON-OFF control of AC power 3.8 SCR application for DC power control

Unit-IV **Integrated circuits**	4a. Explain construction and working of operational amplifier. 4b. Describe IC 741 as Op-Amp. 4c. Explain parameter of op-Amp 4d. Explain application of op-Amp with circuit and waveforms. 4e. Explain working and application of timer IC555.	4.1 Brief introduction to integrated circuits 4.2 Block diagram of typical operational amplifier 4.3 Op-Amp: Open loop, Close loop 4.4 Op-Amp parameters: Input Offset voltages, input offset current, input bias current, CMRR, slew rate, frequency response 4.5 Op-amp applications such as Voltage follower , Inverting amplifier, non-inverting amplifier, summing amplifier, integrator, differentiator, comparator, D-A converter, Wein bridge oscillator 4.6 IC 555: block diagram, working , Pin diagram 4.7 Application of IC 555: Mono stable Multivibrator, Bistable Multivibrator, Astable Multivibrator.

Unit-V **Regulated Power Supply**	5a. Explain working of Regulated Power Supply. 5b. Explain working of different types of Fixed and variable voltage regulator IC. 5c. Describe SMPS applications. 5d. Explain working of solar battery charger circuits.	5.1 Regulated power supply. 5.2 Three Terminal Fixed and Adjustable voltage regulator IC: 78xx, 79xx, LM317. 5.3 Switch mode power supply(SMPS) 5.4 Solar based battery charger circuits.

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	Transistor biasing circuits	05	4	4	4	12
II	Transistor applications.	06	4	4	8	16
III	Thyristors	05	4	4	6	14
IV	Integrated circuits	09	4	8	8	20
V	Regulated Power Supply.	03	2	2	4	08
Total		**28**	**18**	**22**	**30**	**70**

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:

i. Prepare a table and interpret the technical specification of various transistors and thyristors using data sheets.

ii. Compare specifications of various voltage regulator ICs.

iii. Prepare a survey report of different heat sinks used in electronic devices/instruments and list out the alternatives used for heat sinks.

iv. Undertake a market survey of Different types of Amplifiers and oscillators modules.

v. Prepare labeled charts of SMPS

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 to find different ICs used in real time application based on diodes ,transistors and thyristors.

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-projects 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 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) **Transistor Amplifier:** a common emitter amplifier using transistor and prepare a mini project report. (Duration: 6-8 hours)
b) **Op-Amp:** Build any application of op-Amp(IC-741) and prepare a mini project report. (Duration: 6-8 hours)
c) **Oscillator:** Build any basic oscillator circuit and prepare a mini project report. (Duration: 6-8 hours)
d) **Power control** : Build any application of AC powr control using TRIAC
e) **Power control :** Build any application of DC powr control using SCR
f) **Timer IC 555**: Build any circuit using timer IC 555 and prepare a mini project report. (Duration: 6-8 hours)
g) **Battery Chargers:** Build a mobile/USB battery charger using solar cell.
h) **Voltage regulator :** Build variable voltage regulator using LM317

13. SUGGESTED LEARNING RESOURCES

Sr. 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	Principles of Electronics	V.K.Metha, Rohit Mehta	S. Chand, New Delhi, 2014, ISBN: 978-8121924504
4	Fundamentals of Electronic Devices and Circuits	Bell, David	Oxford University Press New Delhi, 2015, ISBN : 9780195425239
5	Electronic Principles	Malvino A. P.	MGH, Latest edition.
6	Op Amps and linear integrated circuit	Gayakwad	Phi
7	Thyristor engineering	M S Berde	Khanna publishers.

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://www.electronicscomp.com/power-supply/battery/battery-protection-board

15. PO-COMPETENCY-CO MAPPING

Semester II	**Electronic Circuits & Applications (Course Code:** 4321104**)**						
	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 & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
Competency	**To maintain various electronic circuits and it's applications**						
Course Outcomes Co1) Use electronic devices for various applications	3	2	2	2	-	-	1
Co2) Test different amplifiers and oscillator.	3	2	2	2	-	-	1

Co3) Use different Thyristors for various applications.	3	2	2	2	-	1	1
Co4) Use integrated circuits for various applications	3	2	2	2	1	2	2
Co5) Build Regulated Power Supply for Green Technology	3	2	3	2	2	2	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
1	Ajay R. Chandegara	G.P. Ahmedabad	9898032871	ajay_chandegara@yahoo.com
2	Bhadreshkumar . B. Renuka	A.V.P.T.I., Rajkot	9426783082	renukasir @gmail.com