GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Electronic Circuits & Applications
(Course Code: 4321103)

Diploma programme in which this course is offered	Semester in which offered
Electronics & Communication Engineering	Second

1. RATIONALE

Electrical, Electronic, Instrumentation 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 components 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 electronics circuits and implement related 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) Compare different biasing techniques of Transistors.
b) Analyze Frequency Response of Transistor Amplifier.
c) Determine performance parameters for transistorized amplifier using H parameter
d) Test different electronic circuits consisting of diodes and transistors.
e) Develop 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	
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: 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 biased type amplifier and measure voltage at different points on the circuit and observe waveforms	I	02*
2	Test thermal stability of fixed biased type amplifier.	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	Calculate h-parameters of CE Amplifier.	III	02*
6	Calculate h-parameters of CB Amplifier.	III	02
7	Build and test different types of clipper circuits.	IV	02*
8	Build and test different types of clamper circuits.	IV	02*
9	Test voltage multiplier circuit.	IV	02*
10	Display numbers using 7 segment LED. (Common Anode and Common Cathode- Both)	IV	02*
11	Build amplifier using Darlington pair and calculate its gain.	IV	02*
12	Build voltage regulator using 78xx and 79xx and measure the dropout voltage for the given voltage regulator.	V	02*
13	Build variable voltage regulator using LM317 and measure the dropout voltage for the given voltage regulator.	V	02*
14	Calculate line regulation of SMPS.	V	02*
15	Build and test one micro 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.

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/ 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 And Thermal stability**	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. Explain compensation techniques for bias stability. 1f. Describe Thermal Runaway and Thermal Stability. 1g. 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 Biasing Methods. 1.4 Stability Factor: Definition and features. 1.5 Compensation techniques for bias stability. 1.6 Thermal Runaway, Thermal Resistance & Thermal Stability. 1.7 Heat Sink and its types.
Unit– II **Frequency Response of Transistor Amplifier**	2a. Define Amplifier Parameters. 2b. Describe effect of Bypass and Coupling Capacitor on Frequency Response. 2c. Explain Single Stage Amplifier. 2d. Compare Coupling Techniques for cascading. 2e. Explain Frequency Response Two Stage RC Coupled Amplifier.	2.1 Gain, Bandwidth and Gain Bandwidth product. 2.2 Effect of Emitter Bypass Capacitor and Coupling Capacitor on frequency response. 2.3 Frequency Response of Single Stage Amplifier. 2.4 Different Coupling Techniques for cascading: Direct, RC, LC and Transformer. 2.5 Frequency Response of Two Stage RC Coupled amplifiers.
Unit-III **Hybrid Parameters**	3a. Describe the h – parameters of two-port network. 3b. Explain h – parameters for Transistor amplifier. 3c. Analysis of h – parameters for Transistor amplifier.	3.1 Two port network, h – parameters and its equivalent circuits. 3.2 h - Parameters for Transistor amplifier. 3.3 Transistor Amplifier parameters- A_v, A_i, A_p, R_o, R_i using h- parameters (No Derivations).
Unit-IV **Applications of Diodes and Transistors**	4a. Determine the output of clipper, clamper and voltage multiplier circuits. 4b. Explain application of different diodes.	4.1 Different types of Clipper Clamper circuits, Voltage Multiplier circuits. 4.2 Seven Segment Display, Infrared (IR) LED, OLED, AMOLED,

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	4c. Use transistors in different applications. 4d. Describe Darlington pair and relay driver with its applications.	Freewheeling (fly back) diode, switching diode, opto-coupler. 4.3 Transistor used as a Tuned Amplifier. 4.4 Darlington Pair and its applications. 4.5 A relay driver circuit using transistors and ICs(TIP122, ULN2003, ULN 2803)
Unit-V **Regulated Power Supply**	5a. Explain working of Regulated Power Supply. 5b. Explain different types of Fixed and variable voltage regulators. 5c. Describe SMPS applications. 5d. Explain UPS. 5e. Explain working of solar battery charger circuits.	5.1 Regulated power supply. 5.2 Shunt voltage regulator. 5.3 Transistorized series voltage regulator (basic and with feedback, without derivation). 5.4 Three Terminal Fixed/ variable voltage regulator: 78xx, 79xx, LM317. 5.5 Switch mode power supply(SMPS) 5.6 Uninterruptible power supply (UPS). 5.7 Solar 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 and Thermal stability.	10	4	6	6	16
II	Frequency Response of Transistor Amplifier.	8	4	4	6	14
III	Hybrid parameters.	4	2	4	2	08
IV	Applications of Diodes and Transistors.	10	4	6	6	16
V	Regulated Power Supply.	10	2	6	8	16
Total		**42**	**16**	**28**	**26**	**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 diodes and transistors using data sheet.
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.
v. Prepare labeled chart of SMPS and UPS.

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 and transistors.

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) **Transistors Application:** Build any application based on transistor and prepare a mini project report. (Duration: 6-8 hours)

c) **Diodes Application:** Build basic applications using any one or combination of diodes, and prepare a mini project report. (Duration: 6-8 hours)

d) **Opto devices:** Build an automatic power saving street light controller circuit using opto devices and prepare a mini project report(Duration 6-8 hours).

e) **Battery Chargers:** Build a mobile/USB battery charger using solar cell.

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	Electronic Device and Circuits	G. S. N. Raju	I K International Publishing House, 2006 ISBN 10: 8189866028 ISBN 13: 9788189866020
5	Fundamentals of Electronic Devices and Circuits	Bell, David	Oxford University Press New Delhi, 2015, ISBN : 9780195425239
6	Basic Electronic Engineering	Baru, V., Kaduskar, R., Gaikwad S.T.	Dreamtech Press, New Delhi, 2015 ISBN: 9789350040126
7	Electronic Principles	Malvino A. P.	MGH, Latest edition.

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

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 electronics circuits and its application.**						
Course Outcomes CO 1) Compare different biasing techniques of Transistors	3	2	2	3	-	3	1
CO 2) Analyze Frequency Response of Transistor Amplifier.	3	2	2	3	-	3	2
CO 3) Determine performance parameters for transistorized amplifier using H parameter	3	2	2	2	-	2	1
CO 4) Test different electronic circuits consisting of diodes and transistors.	3	3	3	3	1	3	2
CO 5) Develop Regulated Power Supply for Green Technology.	3	2	3	1	2	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

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