GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Linear Integrated Circuit (Analog Electronics)
(Course Code: 4341105)

Diploma programmer in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4th Semester

1. RATIONALE

Analogue electronic components and circuits are building blocks for any electronic device used in industries or in daily life. It is therefore necessary for electronics engineers to understand clearly the principle and functioning of the basic analogue components and circuits. This course will enable the students to understand the basics of construction, working, and applications of various types of electronic circuits such as feedback amplifiers, oscillators, power amplifiers, operational amplifiers, and timers using linear ICs. Practical exercises of this course would enable students to maintain such circuits and in turn maintain equipment having such circuits. Understanding of these concepts will be useful to determine the various parameters required to solve various problems and applications. This course has been designed to achieve these aims.

2. COMPETENCY

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

- **Maintain various types of analogue electronic components & circuits.**

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) Study various parameters of negative feedback amplifiers.
b) Measure output of different types of Oscillators.
c) Describe different types of Power amplifier.
d) Test different types of circuits using operational amplifier IC 741.
e) Test multivibrator circuit using timer IC 555.

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

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 subcomponents 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	Test the performance of negative feedback amplifier and compare gain, BW with amplifier without feedback.	I	2*
2	Build / test Colpitts oscillator for variable frequency.	II	2*
3	Build / test Hartley oscillator for variable frequency.	II	2*
4	Build / test UJT as a Relaxation Oscillator.	II	2*
5	Determine efficiency of push pull amplifier.	III	2*
6	Build/ test complementary symmetry push pull amplifier.	III	2*
7	Build / test transformer coupled class-A amplifier.	III	2*
8	Build / test Audio power amplifier circuit using IC 810/LM 386/LM 391	III	2
9	Build / test inverting amplifier using Op-Amp and observe input, output waveforms on CRO.	IV	2*
10	Build non-inverting amplifier using Op-Amp and observe input, output waveforms on CRO.	IV	2*
11	Build / test Integrator/ Differentiator circuit using IC 741 and observe output, input waveforms on CRO for different values of R and C.	IV	2*
12	Build / test Op-Amp as a summing amplifier.	IV	2*

13	Build Astable multivibrator using IC 555 and verify the output waveforms for different values of R and C.	V	2*
14	Build Monostable multivibrator using IC 555 and verify the output waveforms for different values of R and C.	V	2*
15	Build / test Bistable multivibrator using IC 555.	V	2*
16	Study/ Build/ test working of IC 555 as a sequential Timer.	V	2
17*	Prepare mini project using IC 741 (Op Amp)/IC 555(Timer)/IC 556 (Dual Timer)/IC 810, IC 386 (Audio Amplifier)/IC 723(Voltage regulator)	ALL	
	Minimum 14 Practical Exercises		28 Hours

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. *(*) : Only one mini project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. Mini project is group based (group of 3 to 5)*

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	30
3	Follow safe practices measures	10
4	Record observations correctly	30
5	Interpret the result and conclude	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipments with broad specifications for the PrOs is a guide to procure them by the administrators to use 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	1,2,3,4,5

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
2.	Cathode Ray Oscilloscope, Dual Trace 20Mhz, DSO	1,2,3,4,5
3.	Function Generator 0 - 20 MHz with Sine, square and triangular output with variable frequency and amplitude.	1,2,3,4,5
4.	Digital Multimeter: 3 1/2 digit display, 9999 counts digital multimeter	1,2,3,4
5.	Bread Board 840 -1000 contact points: Positive and Negative DC power rails on opposite sides of the board	1,2,3,4,5
6.	Trainer kit for Negative Feedback Amplifier, Oscillators circuit, Power Amplifier Circuit, Audio Power Amplifier, Operational Amplifier using IC 741, Timer IC 555.	1,2,3,4,5

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, electronics, pneumatic instruments and tools.
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	Major Learning Outcomes	Topics and Sub-topics
Unit – I **Amplifiers (Negative Feedback)**	1a. Explain different types of feedback	1.1 Concept of feedback: Negative and Positive
	1b. Describe the effect of feedback on amplifier parameters.	1.2 Gain (Transfer ratio), input impedance, output impedance, stability, bandwidth, frequency response, sensitivity, distortion, and noise of negative feedback amplifier
	1c. List Four basic Feedback Topologies.	1.3 Voltage series amplifier, voltage shunt amplifier, current series amplifier, current shunt amplifier. 1.4 Explain voltage shunt amplifier and current series amplifier.

	1d. List the advantages and disadvantages of negative feedback.	1.5 Advantages and disadvantages of negative feedback
Unit – II **Oscillators** **(Positive Feedback)**	2a. Explain use of positive feedback for oscillator 2b. Describe tank circuit.	2.1 Use of positive feedback in oscillators 2.2 Barkhausen's criteria for oscillation 2.3 Overall gain of positive feedback amplifier. 2.4 Tank circuit
	2c. Explain working and applications of different types of oscillators.	2.5 Hartley oscillator circuit 2.6 Colpitts oscillator circuit 2.7 Wien Bridge oscillator circuit 2.8 Crystal oscillator
	2d. Explain construction, working, characteristics and application of UJT.	2.9 Construction of UJT 2.10 Working and V – I characteristics of UJT 2.11 UJT as a relaxation oscillator
Unit – III **Power Amplifiers**	3a. Differentiate between voltage and power amplifier.	3.1 Working of voltage and power amplifier
	3b. Explain different types of power amplifier and its applications.	3.2 Classification of power amplifier 3.3 Working of different types of power amplifier – Class A, B, AB, C
	3c. Explain working of Push Pull Amplifiers along with waveform & its efficiency.	3.4 Operation of class B push-pull power amplifier 3.5 Efficiency of class B push pull amplifier 3.6 Complementary symmetry push-pull amplifier
	3d. Compare Power Amplifiers.	3.7 Comparison of different types of power amplifiers
Unit – IV Operational Amplifiers (Op Amps)	4a. Explain working of an operational amplifier.	4.1 Basic Block diagram of an operational amplifier
	4b. Describe IC 741 as an Op-Amp.	4.2 Introduction of IC-741 4.3 Pin configuration of IC 741 4.4 Op-Amp: open loop and closed loop
	4c Explain parameters of operational amplifier	4.5 Op-Amp parameters: Input and output offset 4.6 voltage, Input offset current, CMRR, slew rate
	4d. Explain applications of operational amplifiers with sketches.	4.7 Inverting and non-inverting amplifier 4.8 Summing amplifier, Differential amplifier, Integrator
Unit – V Timer Circuits	5a. Explain working of timer IC 555	5.1 Basic operation of IC 555 5.2 Pin Description of IC 555.
	5b. Explain applications of timer IC 555	5.3 Applications of IC 555 : Astable multivibrator, Monostable multivibrator, Bistable multivibrator, Sequential timer

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Amplifiers (Negative Feedback)	09	4	8	2	14
II	Oscillators (Positive Feedback)	09	2	6	6	14
III	Power Amplifiers	10	4	8	6	18
IV	Operational Amplifiers (Op Amps)	10	2	8	6	16
V	Timer Circuits	04	2	2	4	8
Total		**42**	**14**	**32**	**24**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note: This specification table shall be treated as only general guidelines for students and teachers. The actual distribution of marks in the question paper may 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:

- Teacher guided tutorial exercises to solve problems based on all units.
- Implement all circuits on a breadboard and test the output.
- Computer based tutorial (CBT) and videos describing operation and working for all the units.
- Seminars and group discussion.
- Present seminar on any topic related to the subject.

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/subtopics.

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 can 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***.

12. SUGGESTED LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1.	Basic Electronics and Linear Circuits	N.N. Bhargava, Kulshreshtha D., S.Gupta	Tata McGraw-HillEducation,2011
2.	Principles of Electronics	Mehta,V.K.	S. Chand,2004 or latest
3	Op-Amps And Linear Integrated Circuits	Gayakwad,Ramakant A	PHI, Learning,4th Edition
4	Electronics Devices and Circuit Theory	Boylestad, Robert & Louis, Nashelsky	Pearson,10th Edition
5	Analog Electronics	U.A. Bakshi, A. P. Godse	Technical Publication, Pune
6	Fundamentals of Microelectronics	Behzad Razavi	Razavi.cls v. 2006
7	Electronic Principles -with simulation CD	Malvino,A.P.	TataMcGraw-Hill, Education,7thEdition
8	Electronics Devices and Circuits	Mottershead,Allen	PHILearning,2011
9	Fundamentals of Electronic Devices and Circuits	David,ABell	Oxford Press,5thEdition,2008

13. SOFTWARE/LEARNING WEBSITES

a. Electronic WorkBench/MultiSIM /CircuitMaker
b. http://www.nptel.com
c. http://www.allaboutcircuits.com/vol_1/index.html
d. Virtual lab

14. PO-COMPETENCY-CO MAPPING

Semester IV	Linear Integrated Circuit(Course Code: 4341105)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	**Maintain various types of analogue electronic components & circuits.**						

Course Outcomes CO1: Study various parameters of negative feedback amplifier	3	2	2	2	2	2	2
CO2: Measure output of different types of Oscillators	3	3	2	2	2	3	2
CO3: Describe different types of Power amplifier	3	3	2	2	2	3	3
CO 4: Test different types of circuits using operational amplifier IC 741	3	2	3	2	2	3	3
CO 5: Test multivibrator circuit using IC 555	3	3	3	3	2	3	2

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

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Sr. No.	Name and Designation	Institute	Mobile	E-mail
1.	Smt. Kundan N Vaghela, HOD EC Department	Government Girls Polytechnic, Surat.	9825149296	kundanvaghela1@gmail.com
2.	Prof. N. B. Shah, Sr. Lecturer EC Department	Government Polytechnic, Gandhinagar.	7990389214	narendra1201@gmail.com