GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

ANALOG ELECTRONICS

(Code: 3331102)

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	3rd 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 principles 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 components such as UJT, JFET, MOSJFET and circuits such as feedback amplifier, oscillators, power amplifiers, operational amplifier, 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. This course is therefore one of the basic core courses which is must for every electronic engineer and hence should be taken very sincerely by students.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency

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

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	200
4	-	4	8	70	30	40	60	

Legends: L - Lecture; **T -** Tutorial/Teacher Guided Student Activity; **P -** Practical; **C -** Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I **Negative Feedback Amplifiers**	1a. Describe different types of feedback. 1b. List the merits and demerits of negative feedback.	1.1. Concept of feedback: negative and positive 1.2. Merits and demerits of negative feedback
	1c. Explain the concept of negative feedback related to amplifier. 1d. Determine the overall gain of feedback amplifiers for maintenance point of view,	1.3. Negative feedback in amplifiers 1.4. Derivation of equation for overall gain of negative feedback amplifier
	1e. Describe effect of feedback on amplifier parameters.	1.5. Gain, input impedance, output impedance, stability, bandwidth, frequency response, sensitivity, distortion, and noise
	1f. Explain series and shunt type of feedback in amplifier circuits.	1.6. Voltage series amplifier, voltage shunt amplifier, current series amplifier, current shunt amplifier.
Unit – II **Oscillators**	2a. Justify the use of positive feedback in oscillator 2b. Describe working of tank circuit with sketches	2.1. 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 the working principle of different types of oscillators 2d. List applications of various types of oscillators.	2.5. RC phase shift oscillator circuit 2.6. Hartley oscillator circuit 2.7. Colpitts oscillator circuit 2.8. Wien Bridge oscillator circuit 2.9. Crystal oscillator
	2e. Describe construction of UJT with sketches. 2f. Explain the working of the UJT with sketches.	2.10. Construction of UJT 2.11. Working and V – I characteristics of UJT 2.12. UJT as a relaxation oscillator
Unit – III **Power Amplifier**	3a. Differentiate between voltage and power amplifier.	3.1. Voltage and power amplifier 3.2. Classification of power amplifier
	3b. Explain working of different types of power amplifier and their applications.	3.3. Working of different types of power amplifier – Class A, B, AB, C and D
	3c. Determine the efficiency of Class A and Class B type of power amplifiers.	3.4. Efficiency of class A and class B amplifier 3.5. Efficiency of transformer coupled power amplifier

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	3d. Explain working of Push Pull amplifiers 3e. Calculate the efficiencies of Push Pull amplifiers. 3f. Compare the working of different types of power amplifiers.	3.6 Operation of class B push-pull power amplifier 3.7 Efficiency of class B push pull amplifier 3.8 Complimentary symmetry push-pull amplifier
Unit - IV Field Effect Transistor	4a. Explain construction and working principle of JFET 4b. Describe configurations of JFET amplifier.	4.1 JFET: Parameters of JFET – r_d, g_m, μ 4.2 n-channel and p-channel JFET 4.3 JFET configurations: common source, drain and gate
	4c. Differentiate BJT and JFET	4.4 BJT and JFET
	4d. Explain construction and working principle of enhancement type MOSFET 4e. Compare the working of JFET and MOSFET	4.5 Types of MOSFET: enhancement type MOSFET 4.6 JFET and MOSFET as amplifiers
Unit – V Linear Integrated Circuits	5a. Explain working of operational amplifier. 5b. Explain working of differential amplifier.	5.1 Operational amplifier 5.2 Differential amplifier
	5c. Identify the pin specifications and voltage levels of IC 741 in the given sketch, 5d. Explain the open and closed loop concept in Op-amps	5.3 IC-741 and its pin configuration 5.4 Op-Amp: open loop and closed loop amplifier
	5e. Explain the parameters of operational amplifier	5.5 Op-Amp parameters: Input and output offset voltage, Input offset current, Input bias current, CMRR, slew rate, frequency response
	5f. Explain applications of operational amplifier	5.6 Inverting and non-inverting amplifier with derivation of voltage gain 5.7 Summing and differential amplifier, integrator, differentiator, comparator, V-I converter, D-A converter, current booster
	5g. Explain working and applications of Timer IC 555 with a block diagram	5.8 IC 555: basic operation and pin description 5.9 Applications of IC 555: astable, monostable and bistable multivibrator

5. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Negative Feedback Amplifiers	08	2	6	2	10
II	Oscillators	10	2	4	6	12
III	Power Amplifier	12	4	6	6	16
IV	Field Effect transistor	13	4	8	4	16
V	Linear Integrated Circuits	13	2	6	8	16
Total		**56**	**14**	**30**	**26**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF PRACTICAL/EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1	I	Test the performance of negative feedback amplifier and compare gain, BW with amplifier without feedback.	2
2	II	Build/test Colpitts oscillator for variable frequency.	2
3	II	Build/test Hartley oscillator for variable frequency.	2
4	II	Build/test Wien bridge oscillator for variable frequency.	2
5	II	Build/test crystal oscillator.	2
6	II	Build/test UJT as a Relaxation Oscillator.	2
7	III	Test the performance of a n-channel JFET.	2
8	III	Test the performance of a p-channel JFET.	2
9	III	Determine the r_d, g_m, μ for JFET amplifier.	2
10	III	Build and test MOSFET as an amplifier.	2
11	III	Determine the efficiency of push pull power amplifier.	2
12	IV	Determine the of complementary symmetry push pull amplifier.	2
13	IV	Build/test transformer coupled class-A Power amplifier.	2

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
14	IV	Build Audio power amplifier circuit using IC 810/LM 386/LM 391 and test it for different input power rating.	2
16	V	Build inverting amplifier using Op-Amp and observe input, output waveforms on CRO.	2
17	V	Build non-inverting amplifier using Op-Amp and test its performance using the CRO.	2
18	V	Build/test IC 741 using the CRO for different values of R and C.	2
20	V	Build/test Op-Amp as summing amplifier.	2
21	V	Build/test Op-Amp as V to I Converter.	2
22	V	Build/test inverting amplifier using IC 324	2
23	V	Build/test Astable multivibrator using IC 555 for different values of R and C.	2
24	V	Build/test Monostable multivibrator using IC 555 for different values of R and C.	2
25	V	Build/test Bistable multivibrator using IC 555.	2
26	V	Build/test IC 555 as sequential Timer.	2
27	V	Build/test Astable multivibrator using IC 556.	2
28	V	Build/test mini project using IC 41/555/810/723/556/386/391	2
	Total		56

7. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Access websites for collecting s specification of components/ICs using datasheet.
ii. Present seminar on any one topic related to the subject.
iii. Develop a small circuit/ mini project using IC 741/555/810/723/556/386/391.
iv. Explore details of power amplifier IC used in Radio/Television/Home theatre with the help of datasheet available in the handbook.

8. SPECIAL INSTRUCTIONAL STRATEGY (If Any)

i. Computer based tutorial (CBT) describing operation of transistor/JFET and other active components with the help of animations or video films.
ii. Circuit simulation using Software like Electronic work Bench/multiSIM/ Circuit Maker.
iii. Seminars and group discussion.
iv. Mini projects based on op-amp IC or Timer IC.

9. SUGGESTED LEARNING RESOURCES

A) List of Books:

S. No.	Title of Books	Author	Publication
1	Basic Electronics and Linear Circuits	Bhargava, N.,Kulshreshtha D., S.Gupta	Tata McGraw- Hill Education, 2011
2	Electronics Devices and Circuits	Mottershead, Allen	PHI Learning,2011

3	Electronic Principles - with simulation CD	Malvino, A.P.	Tata McGraw- Hill , Education,7th Edition
4	Principles of Electronics	Mehta ,V.K.	S. Chand, 2004 or latest
5	Electronics Devices and Circuit Theory	Boylestad, Robert & Louis, Nashelsky	Pearson, 10th Edition
6	Op-Amps and Linear Integrated Circuits	Gayakwad , Ramakant A	PHI, Learning,4th Edition
7	Electronic Devices and Circuits	Dr. Sharma, Sanjay	KATSON,2012
8	Fundamentals of Electronic Devices and Circuits	David, A Bell	Oxford Press, 5thEdition, 2008

B) List of Major Equipment/Materials

i. Function Generator (upto 100Mhz)
ii. Digital Multimeter (Auto ranging, 3and1/2 digit display)
iii. D.C. Power Supply (0-30volts,10amp.)
iv. Cathode Ray Oscilloscope (50MHz, Dual Trace)
v. Digital Storage Oscilloscope (30MHz, auto capturing)
vi. Experimental Trainer Kits, Bread Board, General Purpose PCB, active and passive components

C) List of Software/Learning Websites

i. Electronic Work Bench/MultiSIM /Circuit Maker
ii. www.nptel.com
iii. www.ocw.mit.edu

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics :

- **Prof. B. P. Raval,** Lecturer, EC Department Government Polytechnic, Rajkot
- **Prof. S. N. Sampat,** Lecturer, EC Department, Government Polytechnic, Gandhinagar
- **Prof.(Smt.) K N Vaghela,** Lecturer, EC Department, Government Polytechnic, Ahmedabad
- **Prof. N. B. Shah,** Lecturer, EC Department, Gvernment Polytechnic,Vadnagar.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Anjali Potnis,** Assistant Professor, Department of Electrical and Electronics Engineering
- **Dr. Joshua Earnest,** Professor, Department of Electrical and Electronics Engineering