

**GUJARAT TECHNOLOGICAL UNIVERSITY**

**BIOMEDICAL ENGINEERING (03)**

**SUBJECT CODE: 2130305**

**Analog Circuits-I**

**B.E. 3RD SEMESTER**

**Type of course:** Basic device modeling and circuit design

**Prerequisite:** Basic knowledge of electronic components and laws such as KCL, KVL, etc.

**Rationale:** This course provides a platform for students to understand working of active devices such as Diode, BJT, and MOSFET, JFET and circuits and systems like amplifier, oscillator and feedback circuits. Students are also taught to analyze and design circuits using these active devices. This is one of the foundation courses which are required for students to understand working of complex electronic circuits and systems.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		C	Theory Marks			Practical Marks		
			ESE		PA(M)		PA(V)		PA(I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

**Content:**

Sr. No.	Content	Total Hrs.	% Weightage
1	<b>Diode Theory, Circuits and applications:</b> Basic Ideas, The Ideal Diode, The Second Approximation, The Third Approximation, Reading a Data Sheet, How to Calculate Bulk Resistance, DC Resistance of a Diode , Load Lines, Half Wave Rectifier, The Transformer, The full Wave Rectifier, The Bridge Rectifier, The Choke –Input Filter, The Capacitor –Input Filter, Peak , Inverse Voltage and Surge Current, Clipper and Limiters, Clampers, Voltage Multipliers, special purpose diodes	12	20%
2	<b>Transistors-Fundamentals, Biasing and applications:</b> <b>BJTs:</b> The Unbiased Transistor, The Biased Transistor, Transistor Types, Various Configurations and Their Characteristics, Transistor Currents, Variation in Current gain, The Load Line, The Operating Point, Recognizing saturation, The Transistor Switch, Emitter Bias, Voltage Divide Bias, Accurate Voltage Divide Bias (VDB) Analysis, VDB Load line and Q-Point, Two Supply Emitter Bias, Other Types of Bias, Voltage amplifier	10	15%
3	<b>JFETs AND MOSFETs:</b> Basic Ideas, Drain Curves, Transconductance Curves, Biasing in Ohmic Region, Biasing in Active Region, Transconductance, JFET Amplifiers, JFET Analog Switch, Other JFET Applications, The Depletion Mode MOSFET,D- MOSFET Curves, Depletion Mode MOSFET Amplifier, The Enhancement Mode	4	5%

	MOSFET		
4	<b>Feedback Amplifier:</b> Introduction, The Basic concepts of Feedback, Effect Of Negative Feedback, Types Of Negative Feedback Connections, Method Of Identifying Feedback Topology and Feedback Factor , Stability Of Feedback Amplifier.	4	5%
5	<b>Operational Amplifiers:</b> Basics, Understanding analog signal processing functions in present day electronic products, Various configuration- inverting, non-inverting and differential circuits and their analysis, Op amp differential amplifier circuit using two op amp and three op amps, Op amp adder, Subtractor, Integrator, Differentiator, Voltage follower circuit, Comparator, op amp non-linear amplifier V to I and I to V converters,	6	10%
6	<b>Op Amp Performance characteristics:</b> Introduction , input offset voltage, input bias current, input offset current, total output offset voltage , thermal drift , effect of variation in power supply voltage on offset voltage , common mode configuration and common mode rejection ratio , offset nulling techniques.	6	10%
7	<b>Op Amp Applications:</b> Op amp voltage regulators, Op amp bridge amplifier, Instrumentation amplifier. Precision rectifier, Schmitt Triggers, window detector, sample and hold circuit, V to F and F to V converters, peak detector, log amplifier and antilog amplifier.	12	20%
8	<b>OP AMP based Oscillator:</b> Oscillators- principles and types, Phase shift oscillator, Wein bridge oscillator, square wave generator, triangular wave generator, sawtooth wave generator, op amp multivibrators, Schmitt trigger and op amp timer.	10	15%
		64	

#### Reference Books:

1. Electronics Principles by Albert Malvino [seventh Edition]
2. Electronics Device and circuits by S Salivahanan and N Suresh Kumar, McGraw Hill Publication [Second Edition or Higher Edition].
3. Electronics Device and circuits by Jacob Milman and Christos C. Halkias, Tata Macgraw Hill Publication [Second Edition].
4. Basic Electronics devices and Circuits by Mahesh B Patil, PHI Learning PVT. Ltd.

#### Course Outcome: After studying this course the student will be able to

1. To apply basic principle of diode and understand its second and third approximation.
2. To analyze the rectifier circuits, clippers and clamper circuits using diodes.
3. To analyze and study the various special purpose diodes
4. To study and understand the bipolar junction transistor.
5. To study and understand the various configuration, biasing methods for transistor.
6. To analyze the basic principle, operation and applications of JFET and MOSFET
7. To analyze various parameters of voltage amplifier.
8. To study and understand the op amp.
9. Design and analyze various op-amp based analog circuits.

**List of Experiments:**

1. Study of diode V-I characteristics.
2. Design of Diode applications, e.g. clipper, clamper
3. Design & Test characteristics of BJT.
4. Design & Test characteristics of FET.
5. Design & Test various biasing circuits of BJT.
6. Design various configurations of BJT.
7. Design an inverting, non-inverting and Instrumentation amplifier.
8. Design of Integrator and differentiator amplifiers.
9. Design of Adder, subtractor and averaging amplifier.
10. Design of OP-AMP based Oscillators.

**Design based Problems (DP)/Open Ended Problem:**

1. Design a Half wave rectifier which has low ripple value.
2. Design a Full wave rectifier which has low ripple value.
3. Design a Full wave bridge rectifier which has low ripple value.
4. Design a regulated power supply using Zener diode.
5. Make a mini project on automatic washroom light on-off.
6. ON/OFF light bulb at 230V using relay and transistor as a switch.
7. Design a CE, CC, and CB amplifier.
8. Design any application using Darlington pair.
9. Simulate experiments using available Electronic Design Automation Tools like Circuit maker, Tina, Multisim, Electronic work bench etc.
10. Seminar/Mini Project

**Major Equipments:**

C.R.O., Function Generator, Power Supply, Multimeter, Digital Storage Oscilloscope, Experimental Trainer Kits, Bread Board, General Purpose PCB

**Active learning Assignments (AL) :** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.