GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS (10) / ELECTRONICS & COMMUNICATION (11) / INSTRUMENTATION & CONTROL (17)

ELECTRONIC DEVICES AND CIRCUITS

SUBJECT CODE: 2131006

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 (E)	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	% Weightag
1	**Semiconductors:** Conductors, Semiconductors, Silicon Crystal, Intrinsic Semiconductors, Two Types of Flow, Doping a Semiconductor, Two Types of Extrinsic Semiconductors, The Unbiased Diode, Forward Bias, Reverse Bias, Breakdown, Energy Levels, The energy Hill, The Barrier Potential and Temperature , Reverse-Biased Diode	**02**	3.84
2	**Diode Theory:** 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	**03**	5.76
3	**Diode Circuits:** The 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	**05**	9.6
4	**Special Purpose Diode:** The Zener Diode, The Loaded Zener Regulator, Second Approximation of a Zener Diode, Zener Drop Out Point, Reading a Data Sheet, Load Lines, Optoelectronics Devices, The Schottky Diode, The Varactor, Other Diodes	**04**	7.68
5	**Bipolar Junction Transistor**: The Unbiased Transistor, The Biased Transistor, Transistor Currents, The CE Connection, The base Curve, Collector Curves, Transistor Approximations, Reading Data Sheets	**04**	7.68
6	**Transistor Fundamentals:** Variation in Current gain, The Load Line,	**04**	7.68

	The Operating Point, Recognizing saturation, The Transistor Switch, Emitter Bias, LED Drivers, The effect of small Changes, More Optoelectronics Devices		
7	**Transistor Biasing:** Voltage Divide Bias, Accurate Voltage Divide Bias (VDB) Analysis, VDB Load line and Q-Point, Two Supply Emitter Bias, Other Types of Bias, PNP Transistors.	**05**	9.6
8	**AC Models:** Base-Biased Amplifier, Emitter-Biased Amplifier, Small-Signal operation, AC Beta, AC Resistance of the Emitter Diode, Two Transistor models, Analyzing an Amplifier, AC Quantities on the data sheet	**04**	7.68
9	**Voltage amplifier:** Voltage gain, The loading effect of input impedance, multistage amplifiers, swamped amplifier, two-stage feedback, **Frequency Effects:** Frequency Response of an Amplifier, Decibel Power gain, Decibel voltage gain, Impedance matching, The Miller Effect	**05**	9.6
11	**CC and CB Amplifier:** CC Amplifier, Output Impedance, Cascading CE and CC, Darlington Connections, Voltage Regulation, The Common Base Amplifier	**04**	7.68
12	**Power Amplifiers:** Amplifier Terms, Two Load Lines, Class-A Operation, Class-B Operation, Class-B Push Pull Emitter Follower, Biasing Class B/AB Amplifiers, Class B/AB Driver, Class-C Operation	**04**	7.68
	JFETs AND MOSFETs: 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 MOSFET	**04**	7.68
13	**Feedback Amplifier:** 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**.**	**04**	7.68
Total		**52**	

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:

1. To apply the principles of semiconductors devices.
2. To apply basic principle of diode and understand its second and third approximation.
3. To analyze the rectifier circuits, clippers and clamper circuits using diodes.
4. To analyze and study the various special purpose diodes such as zener diode, schottky diode, varactor diode and photo diode.
5. To study and understand the bipolar junction transistor.
6. To understand the fundamentals of transistor.
7. To study and understand the various biasing methods for transistor.
8. To study and analyze the various AC models.
9. To analyze various parameters of voltage amplifier.

10. To analyze the CC and CB Amplifier.
11. To study and understand the power amplifier.
12. To analyze the basic principle, operation and applications of JFET and MOSFET.
13. To study and understand the feedback topology of amplifier.

List of Experiments:

Sr No.	Name of the Experiment
1	Obtain I-V characteristic of Diode.
2	To measure ripple factor at the output of (a) Half wave rectifier with and without filter capacitor (b) Full Wave rectifier with and without filter capacitor (C) Bridge rectifier with and without filter capacitor.
3	To verify performance of various Clipper circuits.
4	To verify performance of various Clamper circuits.
5	Obtain I-V characteristic of Zener Diode.
6	Obtain I-V characteristic of photo diode.
7	To obtain characteristic of transistor as a switch circuit.
8	To obtain input and output characteristics and calculate gain of CE amplifier circuit.
9	To obtain input and output characteristics and calculate gain of CB amplifier circuit.
10	To obtain frequency response of single stage transistor amplifier.
11	To obtain the transfer characteristics of FET.
12	To test the performance of negative feedback amplifier and compare gain, BW with amplifier without feedback.
13	To study the effect of (a) voltage series feedback on two stage amplifier (b) current series F/B on single stage CE amplifier.
14	Determine the efficiency of push pull power amplifier
15	Build/test transformer coupled class-A Power amplifier.

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. Design audio amplifier using any type of power amplifier.
10. Design an inverter with n-type enhancement MOSFET and draw its VTC characteristics using NgSpice.
11. Simulate experiments using available Electronic Design Automation Tools like Circuit maker, Tina, Multisim, Electronic work bench etc.
12. Seminar/Mini Project

Major Equipments:

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

List of Open Source Software/learning website:

Ng-spice/Multisim
www.nptel.com

ACTIVE LEARNING ASSIGNMENTS: 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.