INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORMS

Course Title	**ELECTRONIC DEVICES AND CIRCUITS**			
Course Code	**A30404**			
Regulation	**R15 – JNTUH**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	**-**	**-**	**4**
Course Coordinator	B. Naresh, Assistant Professor, ECE			
Team of Instructors	B. Naresh, Assistant Professor, ECE			

I. COURSE OVERVIEW

This course provides the basic knowledge over the construction and functionality of the basic electronic devices such as diodes and transistors. It also provides the information about the uncontrollable and controllable electronic switches and the flow of current through these switches in different biasing conditions. This course is intended to provide information about the different configurations and modes of controllable switches and how these electronic devices can be configured to work as rectifiers, clippers, clampers, oscillators and amplifiers.

II. PREREQUISITE (S)

Level	Credits	Periods / Week	Prerequisites
UG	4	4	Engineering Physics, Engineering Mathematics-I

III. MARKS DISTRIBUTION

Sessional Marks (25 Marks)	University End Marks	Total Marks
Mid Semester Test There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain 4 questions The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 21/2 unit of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	80 minutes	20
2	I Assignment	-	5
3	II Mid Examination	80 minutes	20
4	II Assignment	-	5
5	External Examination	3 hours	75

V. COURSE OBJECTIVES

At the end of the course, the students will be able to

1. Be familiar with the basic P-N junction diode, few special purpose diodes and their functioning.
2. Understand the diode as rectifier and regulator.
3. Be familiar with the construction, current flow, different configurations and modes of the three terminal electronic devices such as BJT and UJT.
4. Be familiar with the different biasing techniques.
5. Be familiar with the field effect transistors and functioning as amplifier.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to

1. Understand the operation of different types of diodes.
2. Analyze the characteristics of different types of diodes.
3. Analyze the diode application circuits.
4. Design diode application circuits.
5. Understand operation of transistors in different configurations.
6. Analyze the characteristics of transistors in different configurations.
7. Understand the biasing for transistor.
8. Understand the stabilization for transistor.
9. Apply the biasing and stabilization for transistor.
10. Analyze the biasing and stabilization for transistor.
11. Understand the operation of FET.
12. Analyze the characteristics of FET.
13. Design the amplifiers using FET.
14. Analyze the amplifiers using FET.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency Assessed By
PO1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	S	Assignments, Tutorials
PO2	**Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	S	Assignments
PO3	**Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and	S	Mini Projects

Program Outcomes		Level	Proficiency Assessed By
	safety, and the cultural, societal, and environmental considerations.		
PO4	**Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Projects
PO5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	Projects
PO6	**The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	N	--
PO7	**Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	N	--
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	--
PO9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	--
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	N	--
PO11	**Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	--
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	S	Lectures, Projects

N - None **S - Supportive** **H - Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed By
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work..	S	Lectures, Assignments
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	S	Projects
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications..	S	Guest Lectures

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS

UNIT - I

P-N Junction Diode: Qualitative Theory of P-N Junction, P-N Junction as a Diode, Diode Equation, Volt-ampere Characteristics, Temperature dependence of VI characteristic, Ideal versus Practical – Resistance levels (Static and Dynamic), Transition and Diffusion Capacitances, Diode Equivalent Circuits, Load Line Analysis, Breakdown Mechanisms in Semiconductor Diodes, Zener Diode Characteristics. **Special Purpose Electronic Devices:** Principle of Operation and Characteristics of Tunnel Diode (with the help of Energy Band Diagram), Varactor Diode, SCR and Semiconductor Photo Diode.

UNIT - II

Rectifiers and Filters : The P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L- Section Filters, π- Section Filters, Comparision of Filters, Voltage Regulation using Zener Diode.

UNIT - III

Bipolar Junction Transistor and UJT: The Junction Transistor, Transistor Current Components, Transistor as an Amplifier, Transistor Construction, BJT Operation, BJT Symbol, Common Base, Common Emitter and Common Collector Configurations, Limits of Operation , BJT Specifications, BJT Hybrid Model, Determination of h-parameters from Transistor Characteristics, Comparison of CB, CE, and CC Amplifier Configurations, UJT and Characteristics.

UNIT - IV

Transistor Biasing and Stabilization: Operating Point, The DC and AC Load lines, Need for Biasing, Fixed Bias, Collector Feedback Bias, Emitter Feedback Bias, Collector - Emitter Feedback Bias, Voltage Divider Bias, Bias Stability, Stabilization Factors, Stabilization against variations in VBE and β, Bias Compensation using Diodes and Transistors, Thermal Runaway, Thermal Stability, Analysis of a Transistor Amplifier Circuit using h-Parameters.

UNIT - V

Field Effect Transistor and FET Amplifiers

Field Effect Transistor: The Junction Field Effect Transistor (Construction, principle of operation, symbol) – Pinch-off Voltage - Volt-Ampere characteristics, The JFET Small Signal Model, MOSFET (Construction, principle of operation, symbol), MOSFET Characteristics in Enhancement and Depletion modes. **FET Amplifiers:** FET Common Source Amplifier, Common Drain Amplifier, Generalized FET Amplifier, Biasing FET, FET as Voltage Variable Resistor, Comparison of BJT and FET.

X. TEXT BOOKS:

1. Millman's Electronic Devices and Circuits – J. Millman, C.C.Halkias, and Satyabrata Jit, 2 Ed.,1998, TMH.
2. Electronic Devices and Circuits – Mohammad Rashid, Cengage Learing, 2013
3. Electronic Devices and Circuits – David A. Bell, 5 Ed, Oxford

XI. REFERENCE BOOKS:

1. Integrated Electronics – J. Millman and Christos C. Halkias, 1991 Ed., 2008, TMH.
2. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, 9 Ed., 2006, PEI/PHI.
3. Electronic Devices and Circuits - K. Lal Kishore, 2 Ed., 2005, BSP.
4. Electronic Devices and Circuits – S.Salivahanan, N.Suresh Kumar, A.Vallavaraj, 2 Ed., 2011, TMH.

IX. COURSE PLAN

At the end of the course, the students are able to achieve the following course learning outcomes

Lecture No.	Unit	Course Learning Objectives	Topics to be covered	Reference
1-3	**I**	To understand the classification of materials and the types of semiconductors.	P-N Junction Diode: Qualitative theory of P-N Junction diode, junction as a diode	T1: 5.1

4-5		To understand the PN Junction is formed and the operation of PN Junction under different external voltages.	Formation of PN Junction, operation PN Junction under forward and reverse direction.	T1: 5.2
6		To study the different currents and obtain the equation for conventional current flow through the diode	Derivation of diode current equation.	T1: 5.3
7		To understand and analyze the cut-in voltage, break down voltages of germanium and silicon diodes, Effect of temp on V-I Characteristics.	V-I Characteristics, Effect of temp on V-I Characteristics of a diode.	T1: 5.6-5.7
8		To analyze the equivalent circuits of a diode.	Comparison of ideal versus practical diode, Equivalent circuits of diode, load line analysis	T1: 5.6 – 5.7 R6: 1.7
9-10		To measure the resistances from VI Characteristics and must know the break down mechanisms.	Static & dynamic resistances, Transition and diffusion capacitance.	T1: 5.8 - 5.10
11		To understand the break down mechanisms of a diode.	Break down mechanisms like avalanche and Zener break down.	T1: 5.12 R6: 1.15
12		To understand the operation of Zener diode.	Operation of Zener diode and V-I Characteristics	T1: 5.12
13		To understand the operation of tunnel diode.	Operation of Tunnel diode, Varactor diode and V-I Characteristics	T1:5.13-5.14 R6: 8.2
14-15		To understand the operation of SCR and semiconductor photo diode.	SCR and semiconductor photo diode.	R6: 8.5-8.6
16-17	**II**	To understand how the PN junction act as a rectifier, operation of half wave rectifier and calculating its harmonic components.	Rectifiers and Filters: PN junction as a rectifier, Operation of half wave rectifier and its corresponding harmonic components.	T1: 6.1-6.2
18-19		To understand the operation of full wave rectifier and calculating its harmonic components.	Operation of full wave rectifier and its corresponding harmonic components.	T1: 6.3
20-21		To understand operation of bridge wave rectifier and calculating its harmonic components.	Operation of bridge wave rectifier its corresponding harmonic components.	T1: 6.4-6.6
22		To understand the operation of L and C filters.	Types of filters, operation of Inductor and capacitor filters	T1: 6.7-6.8
23-24		To analyze the operation of L-section and Pi-section filters.	L-section and Pi-Section filters, comparison of all filters	T1: 6.10-6.13
25		To design Zener diode to act as voltage regulator.	Zener diode as voltage regulator.	T1: 6.15
26	**III**	To understand the basics of BJT, Construction of BJT, and Types of BJT.	Bipolar Junction Transistors and UJT: Introduction to BJT, Construction, symbol	T1: 7.1, 7.4
27		To understand the operation of PNP and NPN Transistors.	Operation of PNP and NPN transistors.	T1: 7.1
28		To understand the current components of a Transistor.	Transistor current components, Transistor as an Amplifier	T1: 7.2-7.3
29		To understand the Input & output characteristics of a transistor in CB configuration.	Input & output characteristics of a transistor in CB configuration.	T1:7.7
30		To understand the Input & output characteristics of a transistor in CE configuration.	Input & output characteristics of a transistor in CE and configuration.	T1: 7.8-7.10
31		To understand the Input & output characteristics of a transistor in CC configuration, know the specifications of transistors.	Input & output characteristics of a transistor in CC configurations, limits of operation	T1: 7.12

32		To understand the h-parameter model.	BJT specifications, BJT Hybrid model	T1:9.6-9.7
33-34		To analyze the transistor amplifier using h-parameters.	Determination of h-parameters from transistor characteristics	T1:9.7
35-36		To understand the different types of Amplifier configurations.	Comparison of CB, CE and CC amplifiers configuration.	R6: 3.5
37		To understand the UJT transistor.	UJT and its characteristics	T1: 12.12 R6: 7.12-7.13
38	**IV**	To analyze the transistor Q point	Transistor biasing and stabilization: Operating point.	T1: 8.1
39		To understand and analyze the DC and AC load lines.	DC and AC load lines.	R6: 4.2
40		To understand and analyze transistor biasing	Need for biasing, fixed bias.	T1: 8.4
41-44		To understand transistor different biasing techniques	Collector feedback bias., Emitter feedback bias, Collector-Emitter feedback bias and voltage divider bias	T1:8.5-8.6
45-46		To analyze the transistor stabilization factor	Bias stability, stabilization factor.	T1: 8.2 R6: 4.4
47		To understand Bias compensation	Bias compensation using diodes and transistor.	T1: 8.9 R6: 4.5
48		To understand Thermal runaway and stability of the BJT	Thermal runaway and stability	T1: 8.12-8.13
49		To analyze the CB transistor amplifier using h-parameters.	h-parameter model for CB amplifier and their comparison.	T1: 10.6
50		To analyze the CE transistor amplifier using h-parameters.	H-parameter model for CE amplifier and their comparison.	T1: 10.4
51-52		To analyze the CC transistor amplifier using h-parameters.	H-parameter model for CC amplifier and their comparison.	T1: 10.5
53-54	**V**	To understand the basics and principles of JFET	Field Effect Transistor and FET Amplifiers: Junction field effect transistor (construction, principle, and symbol)	T1: 12.1
55		To understand the operation of JFET and the concept of Pinch off Voltage.	Junction field effect transistor operation, pinch-off voltage	T1: 12.2
56		To understand the VI characteristics of a JFET	V-I characteristics of JFET	T1: 12.3
57-58		To analyze the small signal model of JFET.	Small signal model of JFET	R6: 7.8
59-60		Must know the basics and principles of MOSFET	MOSFET (construction, principle of operation, symbol), characteristics in enhancement and depletion modes	T1:12.5
61		To understand the operation of MOSFET	MOSFET (principle of operation)	T1: 12.5
62		Must know the characteristics in different modes	MOSFET characteristics in enhancement and depletion modes	R6: 7.7
63		To understand the operation of FET amplifiers	FET Amplifiers: CS, CD Amplifier	R6: 7.1-7.5
64-66		To understand and analyze FET biasing	Biasing FET, Voltage variable resistor and comparison between BJT and FET.	T1: 12.11

XII. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	S	S	S		S							S			
2	S	S	S		S							S			
3	S	S	S		S							S			
4	S	S	S		S							S			
5	S	S	S									S			

S – Supportive H - Highly Related

XIII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	S	S	H									S			
2	S	S	S		S							S			
3	S	H	H		S							S			
4	S	H	S		H							S			
5	H	S	S									S			
6	S	H	H		H							S			
7	S	H	H		S							S			
8	S	H	S		H							S			
9															
10	S	S	H									S			
11	S	S	S		S							S			
12	S	S	S		S							S			
13	S	H	H		S							S			
14	S	H	S		H							S			

S – Supportive H - Highly Related

Prepared By: Mr. B. Naresh, Assistant Professor

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