INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS ANDCOMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRONIC DEVICES AND CIRCUITS**				
Course Code	AECB06				
Programme	B.Tech				
Semester	III	ECE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	1.5
Chief Coordinator	Mr. D Khalandar Basha, Assistant Professor				
Course Faculty	Ms. G Mary Swarna Latha, Assistant Professor Ms. M Sreevani, Assistant Professor				

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 electronic switches and the flow of current through these switches in different biasing conditions. This course is intended to describe the different configurations to provide temperature stability and how these electronic devices can be configured to work as rectifiers, clippers, voltage regulators, clampers and amplifiers.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEEB02	II	Electrical Circuit Analysis	4
UG	AHSB02	I	Linear Algebra and Ordinary Differential Equations	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electronic Devices and Circuits	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**			**Total Marks**
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Quiz
PO 2	**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	3	Assignments
PO 3	**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 safety, and the cultural, societal, and environmental considerations.	2	Term paper/ Assignments
PO 4	**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.	2	Seminars / Mini Project

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	3	Seminars and assignments
PSO 2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	1	assignments
PSO 3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Introduce components such as diodes, BJTs and FETs.
II	Know the applications of components
III	Know the switching characteristics of components.
IV	Give understanding of various types of amplifier circuits.

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe diode operation, transition capacitance, diffusion capacitance and the use of diode in various electronic circuits.	CLO 1	Understand and analyze diodes operation and static and dynamic resistance in order to design basic circuits.
		CLO 2	Understand diffusion and transition capacitance of diode in forward and reverse bias conditions.
		CLO 3	Understand and analyze diode applications and how the diode acts as a switch.
		CLO 4	Design rectifier without and with capacitive filters for the given specifications.
		CLO 5	Understand the use of diodes in typical circuits like, clipping, clamping circuits and comparator circuits.
CO 2	Understand the principle of operation of BJT in CE, CB, CC configuration and analyze transistor hybrid model.	CLO 6	Understand the principle of operation and characteristics of common emitter, common base and common collector configurations.
		CLO 7	Understand the concept of operating point, DC & AC load lines.
		CLO 8	Analyze transistor hybrid parameter model for CE, CB and CC configurations.
		CLO 9	Determine of h-parameters of BJT amplifier from transistor characteristics.
		CLO 10	Understand the use of conversion of h-parameters among CE, CB and CC configurations.
CO 3	Bias the transistors and analyze the low frequency response of BJT amplifiers.	CLO 11	Identify the various transistor biasing circuits, compensation circuits and its usage in applications like amplifiers.
		CLO 12	Analyze various transistor configurations and asses merits and demerits for different applications.
		CLO 13	Analyze CE Amplifier with emitter resistance.
		CLO 14	Analyze low frequency response of BJT Amplifiers.
		CLO 15	Understand the effect of coupling and bypass capacitors on CE Amplifier
CO 4	Study and analyze the behaviour of FET and MOSFET.	CLO 16	Explain construction and principle of operation of JFET.
		CLO 17	Understand the concept of pinch-off voltage and volt-ampere characteristic of JFET.
		CLO 18	Distinguish the constructional features and

COs	Course Outcome	CLOs	Course Learning Outcome
			operation of BJT and FET and their applications.
		CLO 19	Understand biasing of FET and how it acts as voltage variable resistor.
		CLO 20	Discuss the construction of MOSFET and steady the VI characteristics, as it is the prime component in VLSI technology.
CO 5	Analyze FET amplifiers in CS,CG,CD modes using small signal model and study the behaviour of special purpose diodes.	CLO 21	Apply small-signal models to field effect transistors and determine the voltage gain and input and output impedances.
		CLO 22	Analyzes CS, CD, CG JFET amplifiers using small signal model.
		CLO 23	Understand basic concepts of MOSFET amplifiers.
		CLO 24	Explain the operation of Zener diode and its usage in voltage regulating application.
		CLO 25	Understand the principle of operation and characteristics of silicon controlled rectifier, tunnel diode, UJT and varactor diode.

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIVEMENT OF PROGRAMOUCOMES:

Course Outcome	Program Outcomes (PO)					
	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2
CO 1	2	3			3	
CO 2	2				3	
CO 3	2	3	2		3	1
CO 4	2				3	
CO 5	2	3	2	2	3	1

XI. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AECB06.01	CLO 1	Understand and analyze diodes operation and in order to design basic circuits.	PO1	2
AECB06.02	CLO 2	Understand static and dynamic resistance of diode in forward and reverse bias conditions.	PO1	2
AECB06.03	CLO 3	Understand and analyze diode applications and how the diode acts as a switch.	PO1	2
AECB06.04	CLO 4	Design rectifier without and with capacitive filters for the given specifications.	PO1 PO2	3
AECB06.05	CLO 5	Understand the use of diodes in typical circuits like, clipping, clamping circuits and comparator	PO1 PO2	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		circuits.		
AECB06.06	CLO 6	Understand the principle of operation and characteristics of common emitter, common base and common collector configurations.	PO1	2
AECB06.07	CLO 7	Understand the concept of operating point, DC & AC load lines.	PO1	2
AECB06.08	CLO 8	Analyze transistor hybrid parameter model for CE, CB and CC configurations.	PO1	2
AECB06.09	CLO 9	Determine of h-parameters of BJT amplifier from transistor characteristics.	PO1	2
AECB06.10	CLO 10	Understand the use of conversion of h-parameters among CE, CB and CC configurations.	PO1	2
AECB06.11	CLO 11	Identify the various transistor biasing circuits, compensation circuits and its usage in applications like amplifiers.	PO1	2
AECB06.12	CLO 12	Analyze various transistor configurations and asses merits and demerits for different applications.	PO2 PO3	3
AECB06.13	CLO 13	Analyze CE Amplifier with emitter resistance.	PO2	3
AECB06.14	CLO 14	Analyze low frequency response of BJT Amplifiers.	PO2	3
AECB06.15	CLO 15	Understand the effect of coupling and bypass capacitors on CE Amplifier.	PO1	2
AECB06.16	CLO 16	Explain construction and principle of operation of JFET.	PO1	2
AECB06.17	CLO 17	Understand the concept of pinch-off voltage and volt-ampere characteristic of JFET.	PO1	2
AECB06.18	CLO 18	Distinguish the constructional features and operation of BJT and FET and their applications.	PO1	2
AECB06.19	CLO 19	Understand biasing of FET and how it acts as voltage variable resistor.	PO1	2
AECB06.20	CLO 20	Discuss the construction of MOSFET and steady the VI characteristics, as it is the prime component in VLSI technology.	PO1	2
AECB06.21	CLO 21	Apply small-signal models to field effect transistors and determine the voltage gain and input and output impedances.	PO1 PO2	3
AECB06.22	CLO 22	Analyze CS, CD, CG JFET amplifiers using small signal model.	PO3 PO4	2
AECB06.23	CLO 23	Understand basic concepts of MOSFET amplifiers.	PO1	2
AECB06.24	CLO 24	Explain the operation of Zener diode and its usage in voltage regulating application.	PO1 PO4	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AECB06.25	CLO 25	Understand the principle of operation and characteristics of silicon controlled rectifier, tunnel diode, UJT and varactor diode.	PO1	2

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2												3		
CLO 2	2												3		
CLO 3	2												3		
CLO 4	2	3											3		
CLO 5	2	3											3		
CLO 6	2												3		
CLO 7	2												3		
CLO 8	2												3		
CLO 9	2												3		
CLO 10	2												3		
CLO 11	2												3	1	
CLO 12		3	2										3	1	
CLO 13		3											3	1	
CLO 14		3											3	1	
CLO 15	2												3	1	
CLO 16	2												3		
CLO 17	2												3		
CLO 18	2												3		
CLO 19	2												3		
CLO 20	2												3		
CLO 21	2	3											3	1	

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 22			2	2									3	1	
CLO 23	2												3	1	
CLO 24	2			2									3	1	
CLO 25	2												3	1	

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1	SEE Exams	PO 1	Assignments	-	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XIV. ASSESSMENT METHODOLOGIES-INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS:

MODULE -I	DIODE AND APPLICATIONS	Classes: 08
Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Diode Applications: Switch-Switching times. Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifiers With Capacitive Filter, Clippers-Clipping at two independent levels, Clampers-Clamping Operation, types, Clamping Circuit Theorem, Comparators.		
MODULE – II	**BIPOLAR JUNCTION TRANSISTOR (BJT)**	**Classes: 10**
Principle of Operation and characteristics - Common Emitter, Common Base, Common Collector Configurations, Operating point, DC & AC load lines, Transistor Hybrid parameter model, Determination of h-parameters from transistor characteristics, Conversion of h-parameters.		
MODULE - III	**TRANSISTOR BIASING AND STABILIZATION**	**Classes: 10**
Bias Stability, Fixed Bias, Collector to Base bias, Self Bias, Bias Compensation using Diodes and Transistors. **Analysis and Design of Small Signal Low Frequency BJT Amplifiers**: Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors on CE Amplifier.		

MODULE - IV	JUNCTION FIELD EFFECT TRANSISTOR	Classes: 08
Construction, Principle of Operation, Pinch-Off Voltage, Volt- Ampere Characteristic, comparison of BJT and FET, Biasing of FET, FET as Voltage Variable Resistor, MOSFET Construction and its Characteristics in Enhancement and Depletion modes.		
MODULE - V	**FET AMPLIFIERS**	**Classes: 09**
Small Signal Model, Analysis of CS, CD, CG JFET Amplifiers. Basic Concepts of MOSFET Amplifiers. **Special Purpose Devices:** Zener Diode - Characteristics, Voltage Regulator; Principle of Operation - SCR, Tunnel diode, UJT, Varactor Diode.		
Text Books:		
1. Electronic Devices and Circuits - Jacob Millman, McGraw HillEducation. 2. Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, Pearson, 2009.		
Reference Books:		
1. The Art of Electrionics , Horowitz, 3rdEdition Cambridge University Press,2018 2. Electronic Devices and Circuits, David A. Bell – 5th Edition,Oxford. 3. Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, 2 Ed., McGraw Hill,2008. 4. Electronic Devices and Circuits, S. Salivahanan, N.Suresh Kumar, AVallvaraj, 2nd Edition,TMH.		

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No.	Topics to be covered	Course Learning Outcomes	Reference
1	Calculate the dynamic and static resistances of diode	CLO 1	T1:4.1
2	Understand the diode diffusion and transition capacitances	CLO 2	T1: 5.1
3	Understand diode load line and diode applications	CLO 3	R5: 1.7
4	Examine the P-N junction to function as a switch	CLO 3	T1: 5.2
5	Understand and analyze P-N diode as half wave rectifier	CLO 4	T1: 6.1-6.2
6	Understand and analyze P-N diode as half wave rectifier.	CLO 4	T1: 6.1-6.2
7	Understand and analyze P-N diode as full wave rectifier	CLO 4	T1: 6.3
8	Understand and analyze P-N diode as full wave rectifier	CLO 4	T1: 6.3
9	Understand and analyze P-N diode as bridge rectifier	CLO 4	T1: 6.4-6.6
10	Understand and analyze P-N diode as rectifier	CLO 4	T1: 6.4-6.6
11	Understand and analyze C filters	CLO 4	T1: 6.7-6.8
12	Understand and analyze C filters	CLO 4	T1: 6.7-6.8
13	Differentiate between clamping and clipping	CLO 5	R3:7.1, 8.1

Lecture No.	Topics to be covered	Course Learning Outcomes	Reference
14	Analyze Comparator circuits using diodes	CLO 5	R3:7.2
15	Understand the operation of bipolar transistor	CLO 6	T1: 7.1, 7.4
16	Examine the characteristics bipolar transistor	CLO 6	T1: 7.1
17	Elaborate CB characteristics	CLO 6	T1:7.7
18	Elaborate CE characteristics	CLO 6	T1: 7.8-7.10
19	Elaborate CC characteristics	CLO 6	T1: 7.12
20	Analyze operating point DC and AC load lines	CLO 7	R5: 4.2
21	Describe Hybrid model of BJT	CLO 8	T1: 10.6
22	Describe Hybrid model of BJT	CLO 8	T1: 10.4
23	Determine theh parameters	CLO 9	T1: 10.5
24	Conversion of h parameters	CLO 10	T1: 10.5
25	Understand the Transistor biasing	CLO 11	T1: 8.1
26	Understand fixedbias	CLO 11	T1: 8.4
27	Understand self bias circuit	CLO 11	T1:8.5
28	Compare and contrast collector to base bias and self bias	CLO 11	T1:8.6
29	Analyze and design proper Voltage divide bias	CLO 11	T1:8.6
30	Differentiate stabilization and compensation techniques	CLO 11	T1: 8.2 R5: 4.4
31	Differentiate stabilization and compensation techniques	CLO 11	T1: 8.2 R5: 4.4
32	Differentiate stabilization and compensation techniques	CLO 11	T1: 8.9
33	Examine thermal stability	CLO 11	T1: 8.12-8.13
34	Analysis and design of Small Signal Low Frequency CB Amplifiers	CLO 12	T1: 9.1-9.2
35	Analysis and design of Small Signal Low Frequency CC Amplifiers	CLO 12	T1: 9.3.
36	Analysis and design of Small Signal Low Frequency CE Amplifiers with Re	CLO 13	T1: 9.4
37	Analysis low frequency of CE Amplifiers	CLO 14	T1: 9.5
38	Understand the effect of bypass and coupling capacitor	CLO 15	T1: 9.6
39	Understand the operation of FET transistor	CLO 16	R5:7.1-7.3
40	Understand FET construction	CLO 17	R5:7.4
41	Compare and contrast FET and BJT	CLO 18	R5:7.7
42	Indentify how JFET acts as voltage variable resistor	CLO 19	R5:7.7

Lecture No.	Topics to be covered	Course Learning Outcomes	Reference
43	Understand MOSFET operation	CLO 20	R5:7.9-7.16
44	Understand the operation of FET in enhancement mode	CLO 20	T1: 12.1
45	Understand the operation of FET in depletion mode	CLO 20	T1: 12.1
46	Understand FET small signal model	CLO 21	T1: 12.1
47	Understand FET CD amplifier	CLO 22	T1: 12.2
48	Understand FET CS amplifier	CLO 22	T1: 12.3
49	Understand MOSFET amplifier	CLO 23	R5: 7.1-7.5
50	Model the FET circuits	CLO 23	T1: 12.11
51	Model Zener diode as voltage regulator	CLO 24	T1:5.13-5.14 R5: 8.2
52	Elaborate special purpose electronic devices: Tunnel diode, Varactor diode and V-I Characteristics	CLO 25	T1:5.13-5.14 R5: 8.2
53	Understand the operation of UJT.	CLO 25	T1: 12.12
54	Understand the characteristics of UJT	CLO 25	R5: 7.12-7.13

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Design of AC to DC Converters	Seminars / NPTEL	PO 1, PO 2, PO 3	PSO 1
2	Design of amplifiers circuits	Seminars / Guest Lectures / NPTEL	PO 2,PO 3, PO 4	PSO 1
3	Design of electronic circuits on PCB boards.	Laboratory Practices	PO 1, PO 2,PO 4	PSO 1

Prepared by:
Mr. D Khalandar Basha, Asst. Prof.

HOD, ECE