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. V R Seshagiri Rao, Professor				
Course Faculty	Dr. P Ashok Babu,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, oscillators 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	CIAExamination	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- 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 center. 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.
The AAT chosen for this course is given in section XI.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Quiz
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	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.	3	Seminars
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Term paper

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.	2	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.	2	Quiz and 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	Mini Projects

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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 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
AEC001.01	CLO 1	Understand and analyze diodes operation and their characteristics in order to design basic circuits.	PO1	3
AEC001.02	CLO 2	Explain the operation of Zener diode and its usage in voltage regulating application.	PO1	2
AEC001.03	CLO 3	Explain the operational characteristics of various special purpose diodes such as zener diode, tunnel diode, varactor diode, photo diode and unijunction transistor	PO1	2
AEC001.04	CLO 4	Understand the principle of operation and characteristics of silicon controlled rectifier and its application in power supply protection circuit.	PO 1, PO2	2
AEC001.05	CLO 5	Explain half wave rectifier without and with different filters for the given specifications.	PO 1, PO2	3
AEC001.06	CLO 6	Design full wave rectifier without filter and different filters for the given specifications.	PO3	3
AEC001.07	CLO 7	Design and selection of appropriate filter to meet the requirements of voltage regulation and ripple factor	PO3	3
AEC001.08	CLO 8	Write Use of diodes in typical circuits: clipping clamping circuits and comparator circuits.	PO1	2
AEC001.09	CLO 9	Understand the different parameters of transistors such as depletion width and channel width for understanding the functioning and design of this component	PO 1, PO2	2
AEC001.10	CLO 10	Apply small-signal models to field effect transistors and determine the voltage gain and input and output impedances.	PO 1, PO2	2
AEC001.11	CLO 11	Analyze various transistor configurations and asses merits and demerits for different applications.	PO1	2
AEC001.12	CLO 12	Discuss the construction of MOSFET and steady the VI characteristics, as it is the prime component in VLSI technology.	PO1	3
AEC001.13	CLO 13	Distinguish the constructional features and operation of FET and MOSFET and their applications	PO1	2
AEC001.14	CLO 14	Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.	PO3	2
AEC001.15	CLO 15	Identify the various transistor biasing circuits and its usage in applications like amplifiers.	PO1	3
AEC001.16	CLO 16	Explain basic circuits like dc and biasing circuits, small-signal ac circuits with emphasis on single-stage amplifiers.	PO1	2
AEC001.17	CLO 17	Explain the role of temperature variations on the performance of the BJT in order to take necessary measures in design for stabilization.	PO3, PO4	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC001.18	CLO 18	Discuss and Design small signal amplifier circuits applying the various biasing techniques.	PO3	3
AEC001.19	CLO 19	Apply small-signal models to transistors and determine the voltage gain and input and output impedances.	PO2, PO3	3
AEC001.20	CLO 20	Analyze the performance of FETs on the basis of their operation and working.	PO3	3
AEC001.21	CLO 21	Apply the concept of electronic devices and circuits to understand and analyze real time applications.	PO4	2
AEC001.22	CLO 22	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.	PO 4	3

3 = High; 2 = Medium; 1 = Low

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

CLOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												3		
CLO 2	2												1	3	
CLO 3	2												2		
CLO 4	2			2										3	
CLO 5	3	3												3	
CLO 6			3											2	
CLO 7			3											2	
CLO 8	2												3		
CLO 9	2	2											1		
CLO10	2	2												3	
CLO11	2												2		
CLO12	3													2	
CLO13	2													2	
CLO14			2										2		
CLO15	3												3		
CLO16	2												2		
CLO 17			3	3										2	

CLOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 18			3											1	
CLO 19		3	3											1	
CLO 20			3										2		
CLO 21				2									1		
CLO 22				3											3

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT:

CIE Exams	PO 1,PO 2 PO 3,PO 4	SEE Exams	PO 1,PO 2 PO 3,PO 4	Assignments	PO 2	Seminars	PO 3
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES–INDIRECT:

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

XIII. SYLLABUS:

MODULE -I	DIODE AND APPLICATIONS
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)**
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**
Bias Stability, Fixed Bias, and 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**
Construction, Principle of Operation, Pinch-Off Voltage, Volt- Ampere Characteristic, Comparison of BJTand FET, Biasing of FET, FET as Voltage Variable Resistor, MOSFET Construction and its Characteristics in Enhancement and Depletion modes.	
MODULE - V	**FET AMPLIFIERS**

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, VaractorDiode.
Text Books:
1. Jacob Millman,"Electronic Devices and Circuits", McGraw HillEducation. 2. Robert L. Boylestead, Louis Nashelsky, "Electronic Devices and Circuits theory", 11th Edition, Pearson, 2009.
Reference Books:
1. Horowitz, "The Art of Electronics",3rdEdition Cambridge University Press,2018 2. David A. Bell,"Electronic Devices and Circuits", 5th Edition,Oxford. 3. J. Millman, H.Taub and Mothiki S. Prakash Rao, "Pulse, Digital and Switching Waveforms", 2nd Ed., McGraw Hill,2008. 4. S. Salivahanan, N.Suresh Kumar, A.Vallvaraj, "Electronic Devices and Circuits", 2nd Edition,TMH.

XIV. COURSE PLAN:

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

LectureNo.	Topics to be covered	CLOs	Reference
1.	Calculate the dynamic and static resistances of diode	CLO 1	T1: 5.1
2.	Understand the diode diffusion capacitance	CLO 1	T1: 5.1
3.	Understand the diode transition capacitances	CLO 1	T1: 5.1
4.	Understand diode load line	CLO 1	R5: 1.7
5.	Examine the P-N junction to function as a switch	CLO 8	T1: 5.2
6.	Understand and analyze P-N diode as half wave rectifier	CLO 5	T1: 6.1-6.2
7.	Understand and analyze P-N diode as half wave rectifier.	CLO 5	T1: 6.1-6.2
8.	Understand and analyze P-N diode as full wave rectifier	CLO 6	T1: 6.3
9.	Understand and analyze P-N diode as full wave rectifier	CLO 5	T1: 6.3
10.	Understand and analyze P-N diode as bridge rectifier	CLO 6	T1: 6.4-6.6
11.	Understand and analyze P-N diode as rectifier	CLO 5	T1: 6.4-6.6
12.	Understand and analyze C filters	CLO 7	T1: 6.7-6.8
13.	Understand and analyze C filters	CLO 7	T1: 6.7-6.8
14.	Model Zener diode as voltage regulator	CLO 2	T1: 6.15
15.	Differentiate between clamping and clipping	CLO 8	R3:7.1, 8.1
16.	Analyze Comparator circuits using diodes	CLO 8	R3:7.2
17.	Understand the operation of bipolar transistor	CLO 9	T1: 7.1, 7.4
18.	Examine the characteristics bipolar transistor	CLO 10	T1: 7.1
19.	Elaborate CB characteristics	CLO 11	T1:7.7
20.	Elaborate CE characteristics	CLO 11	T1: 7.8-7.10
21.	Elaborate CC characteristics	CLO 11	T1: 7.12
22.	Analyze operating point DC and AC load lines	CLO 14	R5: 4.2
23.	Describe Hybrid model of BJT	CLO 16	T1: 10.6
24.	Describe Hybrid model of BJT	CLO 18	T1: 10.4
25.	Determine the h parameters	CLO 16	T1: 10.5
26.	Conversion of h parameters	CLO 18	T1: 10.5
27.	Understand the Transistor biasing	CLO 16	T1: 8.1
28.	Understand fixed bias	CLO 15	T1: 8.4

LectureNo.	Topics to be covered	CLOs	Reference
29.	Understand self-bias circuit	CLO 15	T1:8.5
30.	Compare and contrast collector to base bias and self-bias	CLO 15	T1:8.6
31.	Analyze and design proper Voltage divide bias	CLO 15	T1:8.6
32.	Differentiate stabilization and compensation techniques	CLO 14	T1: 8.2 R5: 4.4
33.	Differentiate stabilization and compensation techniques	CLO 14	T1: 8.2 R5: 4.4
34.	Differentiate stabilization and compensation techniques	CLO 15	T1: 8.9
35.	Examine thermal stability	CLO 17	T1: 8.12-8.13
36.	Analysis and design of Small Signal Low Frequency CB Amplifiers	CLO 18	T1: 10.6
37.	Analysis and design of Small Signal Low Frequency CC Amplifiers	CLO 18	T1: 10.8
38.	Analysis and design of Small Signal Low Frequency CE Amplifiers with Re	CLO 18	T1: 10.7
39.	Analysis and design of Small Signal Low Frequency CE Amplifiers with bypass capacitor	CLO 18	T1: 10.9
40.	Analysis and design of Small Signal Low Frequency CE Amplifiers without bypass capacitor	CLO 18	T1: 10.9
41.	Understand the operation of FET transistor	CLO 13	R5:7.1-7.3
42.	Understand FET construction	CLO 13	R5:7.4
43.	Compare and contrast FET and BJT	CLO 13	R5:7.7
44.	Understand MOSFET operation w	CLO 12	R5:7.9-7.16
45.	Understand the operation of FET	CLO 20	T1: 12.1
46.	Understand the operation of FET	CLO 20	T1: 12.1
47.	Understand FET CD amplifier	CLO 20	T1: 12.2
48.	Understand FET CS amplifier	CLO 20	T1: 12.3
49.	Understand MOSFET amplifier	CLO 20	R5: 7.1-7.5
50.	Model the FET circuits	CLO 21	T1: 12.11
51-54.	Elaborate special purpose electronic devices:Tunnel diode, Varactor diode andV-I Characteristics	CLO 3	T1:5.13-5.14 R5: 8.2
55.	Understand the operation of UJT.	CLO 3	T1:12.12
56.	Understand the characteristics of UJT	CLO 3	R5:7.12-7.13

XV. 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 / NPTEL	PO 2,PO 3, PO 5	PSO 1
3	Design of electronic circuits on PCB boards.	Guest Lecture	PO 1, PO 3,PO12	PSO 1

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