INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ANALOG AND PULSE CIRCUITS**				
Course Code	AECB11				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. V Vijay, Associate Professor				
Course Faculty	Mrs. KS Indrani, Assistant Professor, ECE Ms. N Anusha, Assistant Professor, ECE Mr. S Lakshmanachari, Assistant professor, ECE				

I. COURSE OVERVIEW:

The course will make them learn the basics to analyze the frequency response of multistage amplifiers and transistor at high frequency. Interpret the concept of feedback and classify various types of feedback amplifiers. Understand the principle of oscillation and design different types of oscillators. Further, design concepts of large signal (power) amplifiers and frequency response of various tuned amplifiers are explained. Finally this course focuses on analysis and design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors than understanding of time base generators.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AECB06	III	Electronic Devices and Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Integrated Circuits Applications	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.	3	Lectures and Assignments
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.	2	Assignments
PO 5	**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.	2	Lab related Exercises
PO 12	**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.	2	Seminars

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	Lectures 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.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Learn the concepts of high frequency analysis of transistors.
II	Understanding of various types of amplifier circuits such as small signal, cascaded, large signal and tuned amplifiers.
III	Familiarize the Concept of feedback in amplifiers so as to differentiate between negative and positive feedback.
IV	Construct various multivibrators using transistors.

IX. COURSE OUTCOMES (COs):

COs	Course Outcomes	CLO's	Course Learning Outcome
CO1	Discuss the frequency response and analysis of multistage amplifiers and transistor at high frequency.	CLO 1	Understand the classification of amplifiers, distortions in amplifiers and different coupling schemes used in amplifiers.
		CLO 2	Analyze various multistage amplifiers such as Darlington, Cascode etc.
		CLO 3	Understand and remember the concept of Hybrid - model of Common Emitter transistor.
CO2	Analyze the effect of feedback on Amplifier characteristics in feedback amplifiers.	CLO 4	Analyze the importance of positive feedback and negative feedback in connection in electronic circuits.
		CLO 5	Analyze various types of feedback amplifiers like voltage series, voltage shunt, current series and current shunt.
CO3	Discuss the frequency response of various oscillators and analyze the large signal and tuned amplifiers.	CLO 6	Understand the condition for Oscillations and various types of Oscillators.
		CLO 7	Design various sinusoidal Oscillators like RC Phase shift, Wien bridge, Hartley and Colpitts oscillator for various frequency ranges.
		CLO 8	Design different types of power amplifiers for practical applications of desired specifications like efficiency, output power, distortion, etc.
		CLO 9	Design the tuned circuits used in single tuned amplifiers and understand its frequency response.
CO4	Understand the linear wave shaping and different types of sampling gates with operating principles using diodes, transistors.	CLO 10	Analyze the response of high pass RC to different non sinusoidal inputs with different time constants and identify RC circuit's applications.
		CLO 11	Understand the basic operating principle of sampling gates.
		CLO 12	Analyze the response of low pass RC circuits to different non sinusoidal inputs with different time constants and identify RC circuit's applications.
CO5	Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.	CLO 13	Illustrate the Bistable multivibrator with various triggering methods and apply design procedures to different bistable multivibrator circuits.
		CLO 14	Analyze the Monostable, Astable multivibrator circuits with applications and evaluate time, frequency parameters.
		CLO 15	Evaluate triggering points, hysteresis width of Schmitt trigger circuit and also design practical Schmitt trigger circuit.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
AECB11.01	CLO 1	Understand the classification of amplifiers, distortions in amplifiers and different coupling schemes used in amplifiers.	PO 1 PO 2	2
AECB11.02	CLO 2	Analyze various multistage amplifiers such as Darlington, Cascade etc.	PO 1 PO 2	2
AECB11.03	CLO 3	Understand and remember the concept of Hybrid - model of Common Emitter transistor.	PO 1	3

CLO Code	CLOs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of Mapping
AECB11.04	CLO 4	Analyze the importance of positive feedback and negative feedback in connection in electronic circuits.	PO 5	2
AECB11.05	CLO 5	Analyze various types of feedback amplifiers like voltage series, voltage shunt, current series and current shunt.	PO 2	2
AECB11.06	CLO 6	Understand the condition for Oscillations and various types of Oscillators.	PO 5	3
AECB11.07	CLO 7	Design various sinusoidal Oscillators like RC Phase shift, Wien bridge, Hartley and Colpitts oscillator for various frequency ranges.	PO 1	3
AECB11.08	CLO 8	Design different types of power amplifiers for practical applications of desired specifications like efficiency, output power, distortion, etc.	PO 1	2
AECB11.09	CLO 9	Design the tuned circuits used in single tuned amplifiers and understand its frequency response.	PO 1	2
AECB11.10	CLO 10	Analyze the response of high pass RC to different non sinusoidal inputs with different time constants and identify RC circuit's applications.	PO 1	3
AECB11.11	CLO 11	Understand the basic operating principle of sampling gates.	PO 1	1
AECB11.12	CLO 12	Analyze the response of low pass RC circuits to different non sinusoidal inputs with different time constants and identify RC circuit's applications.	PO 5	1
AECB11.13	CLO 13	Illustrate the Bistable multivibrator with various triggering methods and apply design procedures to different bistable multivibrator circuits.	PO 1 PO 12	2
AECB11.14	CLO 14	Analyze the Monostable, Astable multivibrator circuits with applications and evaluate time, frequency parameters.	PO 1	3
AECB11.15	CLO 15	Evaluate triggering points, hysteresis width of Schmitt trigger circuit and also design practical Schmitt trigger circuit.	PO 1	3

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				
	PO1	PO2	PO5	PO12	PSO1
CO 1	2			1	1
CO 2	2	2	1	1	2
CO 3	1	2		1	
CO 4		1	2	1	1
CO 5		2		2	1

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

Course Learning Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2	2											1		
CLO 2	2	2											1		
CLO 3	3												1		
CLO 4					2										
CLO 5		2											3		
CLO 6					3										
CLO 7	3														
CLO 8	2														
CLO 9	2												1		
CLO 10	3												1		
CLO 11	1														
CLO 12					1										
CLO 13	2											2			
CLO 14	3												1		
CLO 15	3														

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 5, PO 12 PSO 1	SEE Exams	PO 1, PO 2 PO 5, PO 12 PSO 1	Assignments	PO 1, PO 2 PO 5, PO 12 PSO 1	Seminars	PO 1, PO 2 PO 5, PO 12 PSO 1
Laboratory Practices	PO 1, PO 2 PO 5, PO 12 PSO 1	Student Viva	–	Mini Project	–	Certification	–
Term Paper	–						

XIV. ASSESSMENT METHODOLOGIES – INDIRECT

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

XV. SYLLABUS

Module-I	MULTISTAGE AMPLIFIERS
Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Frequency response and Analysis of multistage amplifiers, Cascade amplifier, Darlington pair. Transistor at High Frequency: Hybrid - model of Common Emitter transistor model, fα, β and unity gain bandwidth, Gain band width product.	
Module-II	**FEEDBACK AMPLIFIERS**
Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations.	
Module-III	**OSCILLATORS AND LARGE SIGNAL AMPLIFIERS**
Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators, Frequency and amplitude stability of Oscillators, Crystal Oscillator. Class A Power Amplifier- Series fed and Transformer coupled, Conversion Efficiency, Class B Power Amplifier- Push Pull and Complimentary Symmetry configurations, Conversion Efficiency, Principle of operation of Class AB and Class C Amplifiers. Tuned Amplifiers: Single Tuned Amplifiers – Q-factor, frequency response of tuned amplifiers, Concept of stagger tuning and synchronous tuning.	
Module-IV	**LINEAR WAVE SHAPING AND SAMPLING GATES**
Linear wave shaping circuits: High pass RC and low pass RC circuits, response to step and square inputs with different time constants, high pass RC circuit as a differentiator, low pass RC circuit as an integrator. Sampling gates: basic operating principle of sampling gate, uni and bi directional sampling gates.	
Module-V	**MULTIVIBRATORS**
Multivibrators: Bistable multivibrator, unsymmetrical triggering, symmetrical triggering; Schmitt trigger; Monostable multivibrator, Astable multivibrator.	
Text Books:	
1. Jacob Millman, Christos C Halkias, "Integrated Electronics" McGraw Hill Education, 2nd Edition, 2010. 2. B.N.Yoganarasimhan, "Pulse and Digital Circuits", 2nd Edition, 2011.	
Reference Books:	
1. David A. Bell, "Electronic Devices and Circuits", Oxford, 5th Edition, 1986. 2. Robert L. Boylestead, Louis Nashelsky, "Electronic Devices and Circuits Theory", Pearson Education, 11th Edition, 2009.	

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	Understand the Classification of Amplifiers, Distortions in amplifiers.	CLO 1	T1:22.9 R1:5.7
2 - 3	Understand multistage amplifier: Different coupling schemes used in amplifiers, RC coupled amplifiers, transformer coupled amplifiers and direct coupled amplifiers.	CLO 2	T1:22.9 R1:5.8
4 - 5	Analysis of cascaded RC coupled bipolar junction transistor amplifiers, Darlington pair.	CLO 2	T1:23.10 R1:6.8
6 - 8	Describe The hybrid-π common emitter transistor model, hybrid π conductance and capacitance, Understand the effect of coupling and bypass capacitors.	CLO 3	T1:22.7 R1:4.4
9-11	Describe common emitter short circuit current gain, current gain with resistive load, alpha, beta cut-off frequencies.	CLO 3	T1:22.8 R1:4.15
12	Describe gain bandwidth product.	CLO 3	T1:22.9 R1:5.4

Lecture No	Topics to be covered	Course Learning Outcomes	Reference
13-15	Concepts of feedback, Classification of feedback amplifiers and General characteristics of Negative feedback amplifiers.	CLO 4	T1:23.9 R1:7.5
16 - 18	Effect of Feedback on Amplifier characteristics-Voltage series, Voltage shunt configurations.	CLO 5	T1:23.9 R1:7.5
19 - 21	Effect of Feedback on Amplifier characteristics-Current series and Current shunt Feedback configurations.	CLO 5	T1:23.10 R1:7.5
22-25	Understand oscillators, Classification of oscillator, conditions for oscillations, RC phase shift oscillator and Wien - bridge and crystal oscillators.	CLO 6	T1:23.10 R1:8.1
26-28	Describe generalized analysis of LC oscillations, Hartley and Colpitts oscillators.	CLO 7	T1:23.1 R1:9.2
29	Frequency and amplitude stability of Oscillators, Crystal Oscillator.	CLO 7	T1:23.1 R1:9.3
30-33	Class A Power Amplifier- Series fed and Transformer coupled, Conversion Efficiency.	CLO 8	T1:23.1 R1:9.4
34-37	Class B Power Amplifier- Push Pull and Complimentary Symmetry configurations, Conversion Efficiency.	CLO 8	T1:23.1 R1:9.9
38-40	Principle of operation of Class AB and Class C Amplifiers.	CLO 8	T1:23.1 R1:9.5
41-44	Tuned Amplifiers: Single Tuned Amplifiers – Q-factor, frequency response of tuned amplifiers, Concept of stagger tuning and synchronous tuning.	CLO 9	T1:23.10 R1:6.13
45-47	Response of High pass RC circuits to step and square inputs with different time constants	CLO 10	T2:1.7,1.9
48-49	Response of Low pass RC circuits to step and square inputs with different time constants	CLO 10	T2:1.19
50	high pass RC circuit as a differentiator, low pass RC circuit as an integrator	CLO 10	T2:1.5
51-53	Sampling gates: basic operating principle of sampling gate, uni and bi directional sampling gates.	CLO 11	T2:1.1
54-57	Types of Triggering, Analysis and Design of Bistable Multivibrators using Transistors.	CLO13	T2:4.3 R2:5.12
58-60	Analysis and Design of Monostable Multivibrators using Transistors.	CLO 14	T2:5.4
61-64	Analysis and Design Astable Multivibrators and Schmitt trigger using Transistors.	CLO14	T2:6.1

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

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Designing of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.	Seminars	PO 1, PO 2	PSO 1
2	Design and analyze the voltage series negative feedback amplifier and find the voltage gain, input and output resistances, and total output offset voltage with feedback.	Seminars / NPTEL	PO 5	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 12	PSO 1

Prepared by:
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