CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EET205	ANALOG ELECTRONICS	PCC	3	1	0	4

Prerequisite: Fundamentals of Electronics and semiconductor devices

CO 1	Design biasing scheme for transistor circuits.
CO 2	Model BJT and FET amplifier circuits.
CO 3	Identify a power amplifier with appropriate specifications for electronic circuit applications.
CO 4	Describe the operation of oscillator circuits using BJT.
CO 5	Explain the basic concepts of Operational amplifier(OPAMP)
CO 6	Design and developvarious OPAMP application circuits.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2									
CO 2	2	2	2									
CO 3			1	2								
CO 4	2	2	2									
CO 5			1	2								
CO 6	2	2	2									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	50
Apply	20	20	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 5 marks for each question. Students should answer all questions. Part B contains Fivesections, Each section have 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 10 marks.

Part A : 10 Questions x 5 marks=50 marks,
Part B : 5 Questions x 10 marks =50 marks

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the different types of biasing methods.(K1,K2)
2. Comment on the effect of Bandwidth and slew rate in Op-amp performance.
3. Draw the Small signal equivalent of differential amplifier and derive the equations for Input resistance, Voltage gain, CMRR.

Course Outcome 2 (CO2):

1. Analyse JFET and MOSFET characteristics.
2. Choose a power amplifier with appropriate specifications for electronic circuit applications.
3. List the features of Instrumentation amplifier.
4. What are the various op-amp feedback configurations? Explain each.
5. Explain the following op-amp circuits with neat sketches also find the output voltage equations
    a. Summing amplifiers
    b. Scaling amplifiers
    c. Averaging amplifiers

Course Outcome 3(CO3):

1. Discuss the different feedback topologies.
2. Analyse the properties of an ideal op-amp.
3. Describe the working of Voltage to current converter using op-amp.
4. Draw the circuit diagrams for Log and antilog amplifier and obtain its output equations.
5. With necessary waveforms and neat diagram explain the working of Schmitt Trigger.
6. Design a Wein Bridge oscillator for a gain of 3 and oscillating frequency of 2kHz.

Course Outcome 4 (CO4):

1. Draw the Small signal equivalent of differential amplifier and derive the equations for Input resistance, Voltage gain, CMRR. (K1, K2)
2. Design various basic op-amp circuits. (K2)
3. Explain the following op-amp circuits with neat sketches also find the output voltage equations
    a. Summing amplifiers
    b. Scaling amplifiers(K2,K3)

Course Outcome 5 (CO5):

1. Generate different desired waveforms using op-amp.(K2,K3)
2. Draw the internal block diagram of 555 Timer IC and explain.(K1)
3. Realise multivibrators using 555 IC. (K2,K3)

Course Outcome 6 (CO6):

1. Design and set up an opamp integrator circuit and plot the input and output waveforms.(K3)
2. Explain the working of a ramp generator circuit using opamp.(K2)

Model Question paper

Reg No.:_____

Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITYTHIRD SEMESTER B.TECH DEGREE EXAMINATION,

MONTH AND YEAR

Course Code: EET205

Course Name: ANALOG ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

1. With neat diagrams explain DC load lines in transistor. What is the significance of Q point?
2. Draw and explain the h parameter small signal low frequency model for BJT.
3. Explain the construction and operation of Enhancement type metal oxide semiconductor FET with neat diagrams.
4. Explain the drain characteristics of JFET and mark the pinch-off voltage
5. Discuss the advantages of negative feedback amplifier.
6. State and explain Barkhausen's criterion of oscillation.
7. Compare the Ideal and Practical characteristics of an op-amp
8. Design a three input summing amplifier using op-amp having gains 2, 3and 5 respectively for each input
9. Show the circuit diagram of an Ideal Differentiator using op-amp with corresponding input and output waveform.
10. Explain the operation of a square wave generator using op-amp.

PART B

Answeranyonefullquestionfromeachmodule.Eachquestioncarries14 Marks

Module1

11. Design a voltage divider bias circuit to operate from a 18V supply in which bias conditions are to be $V_{CE}=V_E=6V$ and $I_C=1.5mA$. $\beta=90$. Also calculate the stability factor S. **(14)**

12. A CE amplifier has the h-parameters given by h_{ie}= 1000Ω, h_{re} = $2*10^{-4}$, h_{fe}=50, h_{0e}= 25μΩ. If both the load and source resistances are 1kΩ, determine the a) current gain and b) voltage gain. **(14)**

Module 2

13. (a) Sketch the frequency response curve of RC coupled amplifier and discuss methods to improve gain bandwidth product **(7)**

    (b) List the four parameters of JFET. Also obtain the mathematical expression for transconductance. **(7)**

14. (a) How a JFET common drain amplifier is designed using voltage divider biasing? **(5)**

    (b)Which are the internal capacitances of a BJT? How these are incorporated in the high frequency hybid pi model of BJT? **(9)**

Module 3

15. Define conversion efficiency of power amplifier. Prove that the maximum conversion efficiency of a series fed class A amplifier is 25%. **(14)**

16. With neat circuit diagrams, explain the working of a two-stage RC coupled amplifier and derive the output relation of each stage. **(14)**

Module 4

17. How do the open-loop voltage gain and closed loop voltage gain of an op-amp differ? What is the limiting value of output voltage of op amp circuit? **(14)**

18. (a) An input of 3V is fed to the non inverting terminal of an op-amp. The amplifier has R_1=10kΩ and R_f=10kΩ.Find the output voltage. **(7)**

    (b) Explain briefly about the following (i) CMRR (ii) Slew Rate **(7)**

Module 5

19. (a) What is the significance of UTP and LTP in Schmitt trigger circuits? **(7)**

    (b) What is a zero crossing detector? **(7)**

20. (a) Explain the functional block diagram of Timer IC555. **(7)**

    (b) Design an astablemultivibrator using 555 Timer for an output wave of 65% duty ratio at 1kHz frequency. **(7)**

Syllabus

Module 1

Bipolar Junction Transistors: Review of BJT characteristics- Operating point of BJT – Factors affecting stability of Q point. DC Biasing–Biasing circuits: fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only).Numerical problems. Bias compensation using diode and thermistor.

BJT Model- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier –Role of coupling capacitors and emitter bypass capacitor. Calculation of amplifier gains and impedances using h parameter equivalent circuit.

Module 2

Field Effect Transistors: Review of JFET and MOSFET(enhancement mode only) construction, working and characteristics- JFET common drain amplifier-Design using voltage divider biasing.

Frequency response of Amplifiers: Internal Capacitances at high frequency operations of BJT- Hybrid Pi model of BJT. Low and high frequency response of Common Emitter amplifier. Frequency response of CE amplifier, Gain bandwidth product.

Module 3

Multistage amplifiers: Direct, RC, transformer coupled Amplifiers, Applications.

Power amplifiers using BJT: Class A, Class B, Class AB, Class C and Class D. Conversion efficiency – derivation(Class A and Class B). Distortion in power amplifiers. Feedback in Amplifiers-Effect of positive and negative feedbacks.
Oscillators:Barkhausen'scriterion–
RCoscillators(RCPhaseshiftoscillatorandWeinBridgeoscillator) –LC oscillators(Hartley and Colpitt's)– Derivation of frequency of oscillation- Crystal oscillator.

Module 4

Operational Amplifiers: Fundamental differential amplifier- Modes of operation.

Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741.

Open loop and Closed loop Configurations-Concept of virtual short. Negative feedback in Op-amps. Inverting and non- inverting amplifier circuits. Summing and difference amplifiers, Instrumentation amplifier.

Module 5

OP-AMP Circuits: Differentiator and Integrator circuits-practical circuits – Design –

Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311.

Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation.

Timer 555IC: Internal diagram of 555IC–Astable and Monostable multi-vibrators using 555 IC.

Text Books

1. Bell D. A., Electronic Devices and Circuits, Prentice Hall ofIndia, 2007.
2. Malvino A. and D. J. Bates, Electronic Principles7/e, Tata McGraw Hill, 2010.
3. Boylestad R. L. and L. Nashelsky,Electronic Devices and CircuitTheory, 10/e, PearsonEducation India, 2009.
4. Choudhury R.,LinearIntegrated Circuits, New AgeInternational Publishers. 2008.

Reference Books

3. Floyd T.L., Fundamentals of Analog Circuits,, Pearson Education, 2012.
4. Robert T. Paynter and John Clemons, Paynter's Introductory electronic devices & circuits, Prentice Hall Career & Technology, New Jersey.
5. Millman J. and C. C. Halkias,Integrated Electronics: Analog and Digital Circuits andSystems, Tata McGraw-Hill, 2010.
6. Streetman B. G. and S. Banerjee,Solid State Electronic Devices, Pearson Education Asia,2006.
7. Gayakward R. A., Op-Amps and LinearIntegrated Circuits, PHILearning Pvt.Ltd., 2012.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1		**10**
1.1	Bipolar Junction Transistors: Review of BJT characteristics	1
1.2	Operating point of BJT – Factors affecting stability of Q point.	1
1.3	Biasing circuits: fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only). Numerical problems.	4
1.4	Bias compensation using diode and thermistor.	1
1.5	BJT Model- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier	1
1.6	Role of coupling capacitors and emitter bypass capacitor.	1
1.7	Calculation of amplifier gains and impedances using h parameter equivalent circuit.	1
2		**8**
2.1	Field Effect Transistors: Review of JFET and MOSFET (enhancement mode)-construction, working and characteristics	2
2.2	JFET common drain amplifier-Design using voltage divider biasing.	1
2.3	FET as switch and voltage controlled resistance.	1
2.4	Frequency response of Amplifiers: Internal Capacitances at high frequency operations of BJT- Hybrid Pi model of BJT. Low and high frequency response of Common Emitter amplifier	3
2.5	Frequency response of CE amplifier, Gain bandwidth product	1
3		**9**
3.1	Multistage amplifiers: Direct, RC, Applications.	1
3.2	Transformer coupled Amplifiers, Applications.	1
3.3	Derivation of conversion efficiency of Class A and Class B amplifiers.	2

3.4	Class AB, Class C and Class D amplifiers. Distortion in power amplifiers(Class A, Class B, Class AB, Class C and Class D)	2
3.5	Oscillators: Barkhausen's criterion–RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) Derivation of frequency of oscillation	2
3.6	LC oscillators (Hartley and Colpitt's) – Derivation of frequency of oscillation- Crystal oscillator.	1
4		**10**
4.1	Operational Amplifiers: Fundamental differential amplifier- Modes of operation.	2
4.2	Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741.	3
4.3	Open loop and Closed loop Configurations-Concept of virtual short.	2
4.4	Negative feedback in Op-amps.	1
4.5	Inverting and non- inverting amplifier circuits	1
4.6	Summing and difference amplifiers, Instrumentation amplifier.	1
5		**8**
5.1	OP-AMP Circuits: Differentiator and Integrator circuits-practical circuits - Design	1
5.2	Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311.	2
5.3	Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation.	2
5.4	Timer 555IC: Internal diagram of 555IC–Astable and Monostable multi-vibrators using 555 IC.	3