U.G. 4th Semester Examination - 2022

PHYSICS

[HONOURS]

Course Code : PHY-H-CC-T-10

(Analog Systems and Applications Theory)

Full Marks : 40 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP–A

1. Answer any **five** questions: 2×5=10

   a) "The barrier potential across a p-n junction diode cannot be measured by placing a voltmeter across the diode terminals." – Explain.

   b) Explain the phenomenon punch through in a transistor.

   c) A certain Colpitts oscillator uses a tank circuit with L=20 mH, C_1=200 pF and C_2 = 100 pF. What is the frequency of the oscillation?

   d) Calculate β of a transistor for which $\alpha = 0.96$. If α changes by 0.1 %, what is the percent change in β?

   e) Show how a logarithmic amplifier can be built with an OP-AMP.

   f) Why are CC and CB amplifiers not suitable for cascading?

   g) What is the desired position of the Q-point for a minimum distortion and why?

   h) In a Zener diode regulator the series resistance is 25Ω Zener voltage 15 V and load resistance 100Ω. The input voltage varies from 20 to 30V. Calculate the minimum and maximum current in the Zener diode.

2. Answer any **two** questions: 5×2=10

   a) "Negative feedback reduces the gain of an amplifier still this type of feedback is widely used." Why? The open loop gain of an amplifier changes by 6%. If 10 dB negative feedback is applied, calculate the percentage change of the closed loop gain. 2+3

   b) What is self bias? Draw the circuit diagram showing the self bias of an NPN transistor in the CE configuration. Explain physically how the self biasing resistor improves the stability. 1+2+2

c) Why are junction transistors called bipolar devices? What is early effect? With respect to CB output characteristics of a transistor explain the active saturation and cutoff regions. 1+1+3

d) State the different methods of coupling of amplifiers. Give a brief account of class A, B, AB and C amplifiers. 2+3

3. Answer any **two** questions: 10×2=20

a) Discuss the mechanism of amplification obtained in a transistor. What is the origin of the name 'transistor'? Draw a neat circuit diagram of an emitter follower. A transistor having $\alpha = 0.97$ and a reverse saturation current $I_{CO} = 13\ \mu A$, is operated in CE configuration. What is β for this configuration? If the base current is $240\ \mu A$, calculate the emitter current and the collector current. 3+1+2+4

b) What are the advantages of using h-parameters (two port representation of transistor) model? Draw the small signal low frequency hybrid parameter equivalent circuit of a CE amplifier and derive expression for current gain, voltage gain, input impedance and output impedance.

A transistor amplifier in CE configuration couples a source of internal resistance $2\,k\Omega$ to a load of $20\,k\Omega$. Find the input and the output resistances if $h_{ie} = 1$. 1+(2+4)+3

c) Explain the virtual ground concept in OP-AMP with a diagram. Show how an OP-AMP can be used as summing amplifier, subtractor and integrator. Calculate the actual output voltage of an integrator after 2 seconds for the input voltage of 1 V d.c. Given that input resistance equal to $200\,k\Omega$ and feedback capacitance $1\ \mu F$. 2+(2+2+2)+2

d) What is a D/A converter? Explain the principle of operation of a weighted-resistor D/A converter. What is its disadvantage and how is it removed in a ladder converter? In a 4-bit weighted resistor D/A converter the resistor value corresponding to LSB is $16\,k\Omega$. Find the resistor value corresponding to MSB. 1+3+(1+3)+2

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