Ex/ET/PC/B/T/215/2024(S)

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING SECOND YEAR
FIRST SEMESTER SUPPLEMENTARY EXAM - 2024

ANALOG CIRCUITS- I **Time: Three hours** **Full Marks: 100**

(All parts of the same question must be answered together)

Module I [Answer any one (1×10=10)] CO1

1. a) Explain the working of negative clamper circuit. Draw the required waveforms. [3+2]
   b) Explain the working of series clipping circuit to clip the input sinusoidal signal above reference level. Draw the waveforms and transfer characteristics. [5]

2. a) Draw full-wave rectifier circuit and explain its operation. [2+4]
   b) Find the approximate expression for ripple factor of half wave rectifier without capacitor filter. [4]

Module II [Answer any one (1×10=10)] CO2

3. a) Consider symmetrical square wave input applied to a low-pass *RC* circuit. Sketch the input and output waveforms and obtain the expression for maximum and minimum values of output voltage. [8]
   b) Explain low pass filter as an integrator. [2]

4. Describe the problem of uncompensated attenuator and find condition for perfect compensation. Draw output waveforms for over, under and perfect compensation. [3+4+3]

Module III [Answer any two (2×20=40)] CO3

5. a) What do you understand by transistor biasing? Draw load line on output characteristics and show operating point. [5]
   b) For an emitter bias circuit, derive an expression for stability factors S_{Ico}, S_{VBE}, and S_β . [9]
   c) Calculate S_{Ico}, S_{VBE}, and S_β for $R_C = 3.3k\Omega$, $R_B = 220k\Omega$, $R_E = 1k\Omega$, $V_{CC} = 10V$, $\beta = 150$. [6]

6 a) Explain the effect of coupling capacitances on voltage gain at low frequency. [3]
   b) Consider npn BJT in common emitter configuration working with self bias , bypassed emitter resistance mode. Obtain expressions for input impedance, output impedance and voltage gain. Draw the small signal model(g_m-r_π). [9]
   c) Determine voltage gain, input impedance and output impedance of a self bias , bypassed source resistance mode MOSFET amplifier with $R_D = 1k\Omega$, $R_S = 220\Omega$, $V_{DD} = 5V$, $V_{DS} = 2V$, $V_{GS} = 1V$, $Kn = 1mA/V^2$ and $V_{Th} = 0.5V$. [8]

7. a) Write advantages and disadvantages of MOSFET amplifier over BJT amplifiers. [4]
   b) The data sheet of N channel JFET gives the following details. I_{DSS}=10mA and pinch off voltage of -4.8V. Determine i) V_{GS} at I_D=2.5mA and ii) transconductance, g_m at this drain current. [3+3]
   c) Explain Miller effect associated with CS mode FET amplifier with the help of small signal model? Explain Cascode amplifier to avoid Miller effect. [5+5]

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Module IV [Answer any one (2×15=30)] CO4

8.
a) Write down six characteristics of an ideal op-amp. [3]
b) Explain origin of input offset voltage, input bias current of a practical op-amp. [4]
c) How do CMRR and Slew rate influence the performance of an op-amp? [4]
d) Explain a balanced differential amplifier using BJT [4]

a) Analyze the circuit diagram of an Instrumentation amplifier using op-amp. Derive the expression for the output voltage. [4+8]
b) The datasheet of Op Amp gives the following values. Open loop Gain= 175,000, common-mode gain =0.18 and slew rate= 0.5V/μs. Determine the CMRR in decibels. [3]

9.
a) Define line and load regulation of a voltage regulator. [4]
b) Explain the short circuit protection circuit in a series voltage regulator. [6]
c) Draw and explain the output waveform of an integrator circuit for a triangular input. [5]

Module V [Answer any one(10)] CO5

10 a) Design a Zener voltage regulator to provide regulated output voltage of 5.6 V for a variable load resistance that varies from 300Ω to 6kΩ. Zener diode parameters are I_{Zmin}= 0.25 mA and P_Z= 280mW .The input voltage is considered as constant at 15V. [5]

b) Design an Op Amp circuit to get the output according to the given expression. VO =-[0.3V1+3V2+V3] where V1,V2 and V3 are the inputs to op-amp. [5]

11 Design a Voltage divider circuit for a silicon transistor with hfe=100 and S≤8. The desired Q-point is V_{CE}=5V, I_C=1mA. Assume V_{CC}=10V and R_E=1kΩ. [10]