Ref. No.: Ex/ET/PC/B/T/221/2025

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
SECOND YEAR SECOND SEMESTER EXAM, 2025

ANALOG CIRCUITS- II **Time: 3 hours** **Full Marks: 100**

(All parts of the same question must be answered together)
use separate answer script for each part

PART-I (70)

Answer Any Three (3×20=60) CO1, CO2,CO3

1. a) Why are multistage amplifiers used in electronic circuits? Discuss the different types of coupling methods used in multistage amplifiers. [3+3]
   b) Explain that the gain bandwidth product of a capacitive coupled CE amplifier is constant. [4]
   c) Determine mid frequency voltage gain, input resistance and output resistance with the help of small signal equivalent circuit of two stage amplifiers using MOSFETs. [10]

2. a) Compare power amplifiers and voltage amplifiers, highlighting their key differences. Classify power amplifiers and define them. [3+3]
   b) With the help of a circuit diagram and load lines determine the maximum conversion efficiency of class-B push-pull amplifier. [5]
   c) Explain that the practical efficiency of class-B power amplifier is smaller than theoretical maximum. [4]
   d) An LM380 audio power amplifier is used to deliver 2 W of power to an 8Ω speaker. The amplifier is powered with a 15 V DC supply, and the efficiency of the amplifier is 40%. The maximum junction temperature T_{Jmax} of the IC is 150°C, and the ambient temperature T_A is 35°C. The thermal resistances are: junction-to-case, θ_{JC} =3° C/W and case-to-sink, θ_{CS} =1° C/W. Calculate the maximum allowable thermal resistance of the heat sink θ_{SA} to ensure safe operation. [5]

3. a) What are the advantages of tuned amplifiers? Why cannot tuned circuits be used at audio frequency? [3+3]
   b) Draw and explain the double tuned amplifier. [4]
   c) Determine the condition to achieve maximum BW from the frequency response of double tuned amplifiers for different coupling coefficients. [10]

[Turn over

4. a) Draw the schematic of Schmitt Trigger circuit using BJTs and explain the operation. [10]
   b) Find the expression for the time period of square wave produced by astable multivibrator using BJTs. [10]

5. a) What are the various feedback topologies? Explain with block diagrams. [2+8]
   b) What is the topology used in the following circuit (Figure 1) where A is the open loop voltage gain. Find the expression for loop gain and closed loop voltage gain. Calculate input and output impedances of the closed circuit if R_{in} and R_o are input and output resistance of the open loop amplifier. [2+4+4]

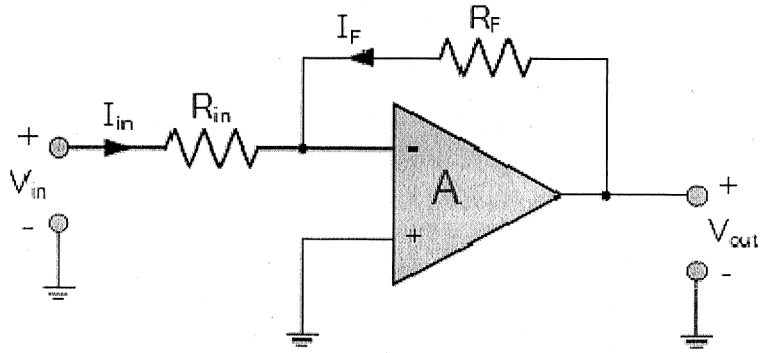

Figure 1

Answer Any One (1×10=10) CO4

6. Design a cascode amplifier for voltage gain =20. Given that V_{DD}=10V, g_m=5mS. If output capacitance and gate drain capacitance are given as 1pF and 0.1pF respectively, calculate the BW of the amplifier. Compare the calculated BW with a CS amplifier offering the same voltage gain and capacitances. Comment on the result. [10]

7. Design a class C tuned amplifier to amplify 1MHz signal. If the inductor is associated with a series resistance of 10 Ω, find the BW of the amplifier. [10]

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PART –II

(Answer any two)

Full Marks : 15x2 = 30

1. Using a 555 IC, **implement** an Astable Multivibrator and plot the following waveforms with explanations: $\mathbf{V_{Threshold}}$, $\mathbf{V_{Trigger}}$, $\mathbf{V_{ff\text{-}Set}}$, $\mathbf{V_{ff\text{-}Reset}}$, $\mathbf{V_{Disch}}$, and $\mathbf{V_{Out}}$. Find the value of external **components** so that T_H= 1msec and T_L= 0.5msec. *(Assume the SR flip-flop used in the IC is a positive edge trigger FF, and use 5V supply voltage for your design)*
[Marks: 2+9+4=15]

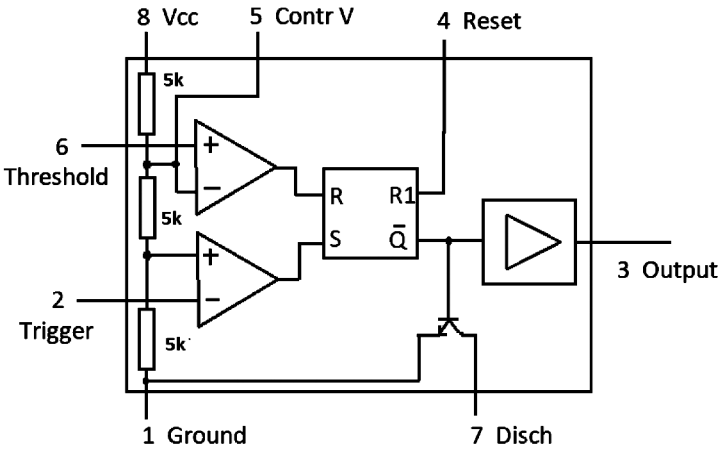

Figure 1

2. For the voltage-controlled oscillator shown in Figure 2, derive the expressions for $\mathbf{T_L}$ and $\mathbf{T_H}$. If the input voltage to the circuit is 5V and the supply voltage of each Op-amp is ±15V, plot $\mathbf{V_{Cap}}$ *(voltage across the capacitor),* $\mathbf{V_{Out1}}$, and $\mathbf{V_{Out2}}$ with respect to time.
[Marks: (3+3)+(3+3+3)=15]

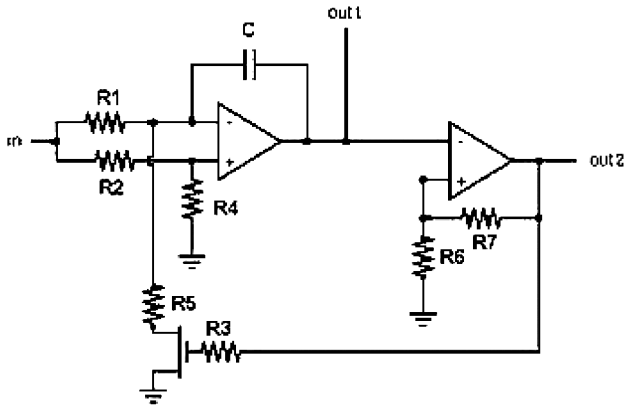

Figure 2

3. An astable multivibrator circuit is modified as shown in figure 3. Assume the diode shown in the figure is ideal. Plot waveforms $\mathbf{V_{01}}$, $\mathbf{V_{02}}$, $\mathbf{V_{x1}}$, and $\mathbf{V_{x2}}$ with respect to time (*use proper labels, shapes, and maintain approximate visualization of duty cycle and voltage values in your plot*). Calculate the **time period** and **duty cycle** of the output waveform $\mathbf{V_{o2}}$.

[Marks: (3+3+3+3)+(2+1)=15]

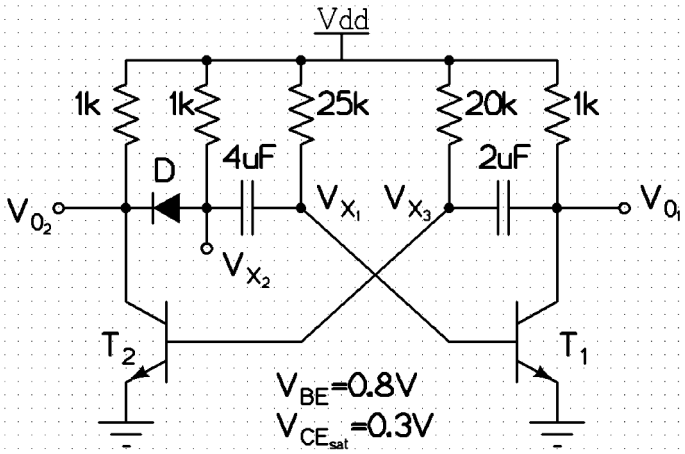

Figure 3

4. The circuit shown in Figure 4 is implemented using all ideal components with sufficient supply voltage to the Op-amps. If R = 10KΩ and C = 1μF find the **Condition** for sustained oscillation and the **Frequency** of oscillation (in Hz). [Marks: 10+5=15]

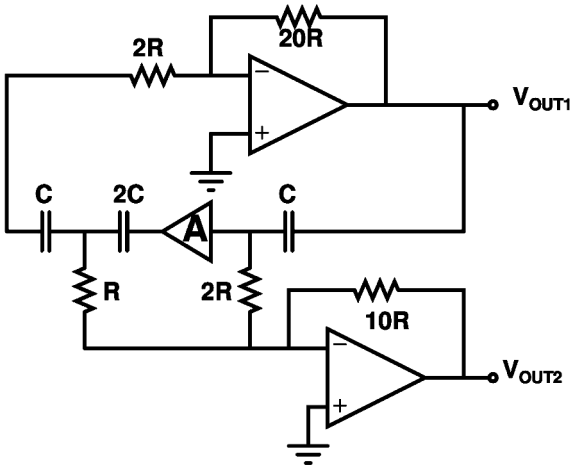

Figure 4