Z/K/TY

Reg. No:

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)

Final Assessment Test – November 2025

Course: **BECE206L - Analog Circuits**

Class NBR(s): **0474 / 0478 / 2656 / 2659 / 2663 / 3560** Slot: **D2+TD2**

Time: **Three Hours** Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

COs	CO Statements
CO1	Design the BJT and MOSFET amplifier circuits using suitable biasing techniques and analyze their frequency response characteristics.
CO2	Distinguish among different classes of MOSFET power amplifiers and employ them for various applications.
CO3	Analyze the different active biasing techniques and MOSFET-based differential amplifiers and their frequency response characteristics.
CO4	Comprehend the ideal characteristics of OP-AMPs and design the fundamental circuits based on OP-AMPs.
CO5	Design and analyze different waveform generator circuits using operational amplifiers.
CO6	Analyze the basic concept of filter circuits, multivibrators using 555 timer, and data converter circuits.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions

(10 X 10 = 100 Marks)

1. For the circuit shown below in the Figure.1, current flowing through the collector terminal $I_C = 1\ mA$ and β = 100. **CO1 BL3**

   a) Draw the AC small-signal equivalent circuit.

   b) Calculate small-signal parameters: r_π, g_m, r_o $(V_A = 100\ \text{V})$

   c) Find the mid-band voltage gain $A_v = V_o/V_i$.

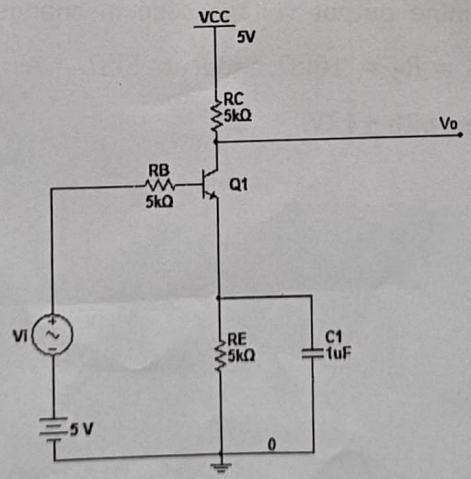

Figure 1

2. Consider an n-channel MOSFET in a common-source arrangement with a gate voltage divider. The following values are given: CO1 BL3

$V_{DD} = 12$ V, $R_D = 4.0$ kΩ, $R_S = 1.0$ kΩ, $R_1 = 220$ kΩ $(Gate\ to\ V_{DD})$, $R_2 = 100$ kΩ $(Gate\ to\ ground)$, $V_{th} = 2.50\ V$, $K_n = 0.5\ mA/V^2$. Assume that the MOSFET operates in saturation.

(i) Solve for the DC drain current I_D.

(ii) Calculate $V_S, V_D\ and\ V_{DS}$ and verify saturation.

Compute the Q-point and comment on stability.

3. Consider a Class-B output stage amplifier circuit to deliver an average power of 20W to an 8Ω load. The power supply is to be selected such that V_{DD} is about 8V greater than the peak output voltage. Determine the supply voltage required, the peak current drawn from each supply, the total supply power, and the power conversion Efficiency. Also calculate the maximum power that each transistor must be able to dissipated safely. CO2 BL2

4. Consider a MOSFET differential pair, where $K_n = 8\ mA/V^2$, $V_A = 10$V, $V_{GS} = 2$V, $V_t = 0.8$V, $R_D = 1$kΩ and $R_{SS} = 15$kΩ. CO3 BL3

(i) Determine A_d and A_{cm} and $CMRR$ in dB, if the output is taken single ended and circuit is properly matched.

(ii) Determine A_d and A_{cm} and $CMRR$ in dB, if the output is taken double ended.

5. Consider the circuit such as the one shown in Figure 2 is used to combine the different signals. CO4 BL3

$V_1 = 1.5\ \sin 2\pi 100t$, $V_2 = 1\ \sin 2\pi 100t$, $V_3 = 1\ \cos 2\pi 100t$, and $V_4 = 2V$ DC voltage. Determine output voltage seen in channel A of the oscilloscope if $R_1 = R_2 = R_3 = R_5 = 10$kΩ, and $R_4 = 5$kΩ. Assume all the OPAMP are ideal and powered with ±12V.

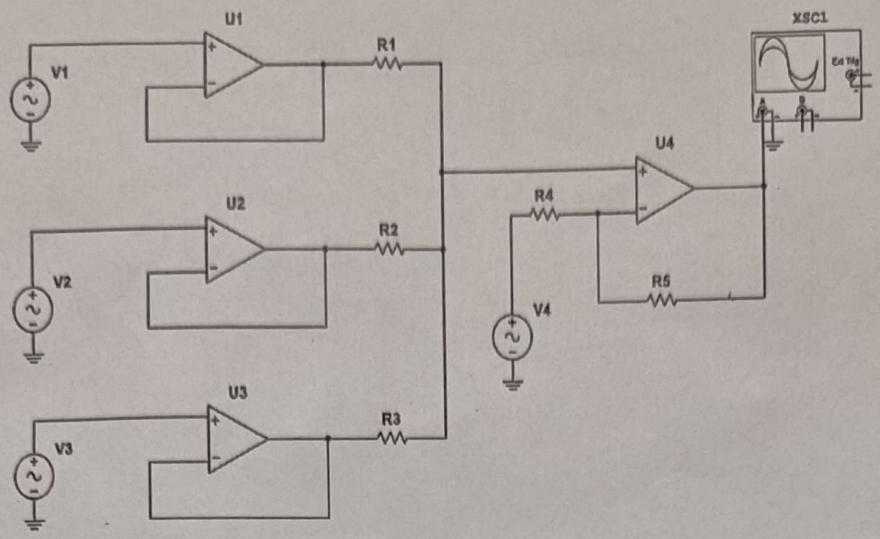

Figure 2

6. Draw a neat diagram of three op-amp instrumentation amplifier. Consider resistor values of final stage of instrumentation amplifier as follows: R_1 = 12 kΩ, R_2 = 6 kΩ, R_3= 12 kΩ, and R_4 = 6 kΩ, find the output voltage for the input voltages of V_1 = 3 V and V_2 = 2.5 V. Also calculate the current flowing through resistor R_2 = 6 kΩ assuming ideal op-amps. **CO4** **BL3**

7.(a) Draw an OPAMP based Astable multivibrator circuit using the given components (R_1 = 55 kΩ, R_2 = 40 kΩ, R = 60 kΩ, and C = 0.001 μF). Derive the expression for total time period and calculate the time period using the specified values. **CO5** **BL3**

OR

7.(b) Find the upper threshold and lower threshold voltages of the given Schmitt trigger shown in Figure 3. And also, draw the hysteresis loop and comment on the duty cycle. Consider OPAMP and diodes are ideal. **CO5** **BL3**

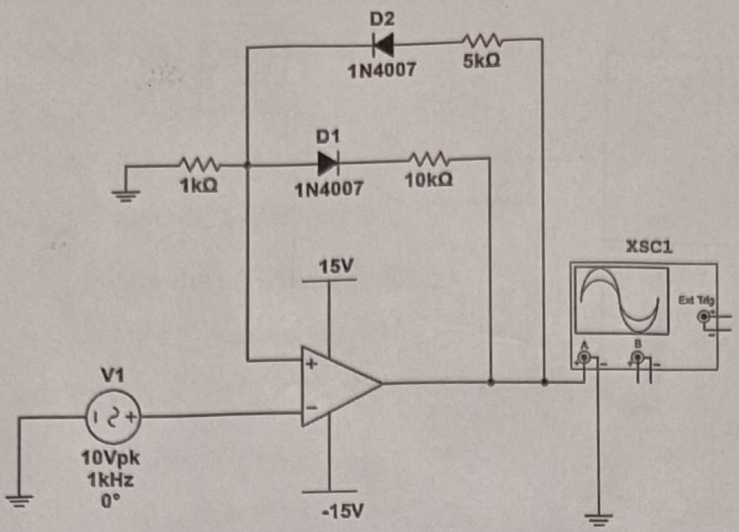

Figure 3

8. Design a second order Butterworth high pass filter with a cutoff frequency of 10 kHz and passband gain of 1.5 using op-amps. Calculate the values of resistors and capacitors. Plot the frequency response of the filter. **CO6 BL3**

9.(a) Illustrate the Successive Approximation Register ADC process and explain how the binary search is implemented. **CO6 BL2**

OR

9.(b) Explain the operation of a 4-bit R-2R ladder DAC with a neat diagram. Find the relation between output voltage to the Full Scale Voltage (V_{FS}) for the given digital input 1000. **CO6 BL2**

10. Derive the time period of a linear ramp generator circuit using IC 555 timer as shown in the Figure 4. **CO6 BL3**

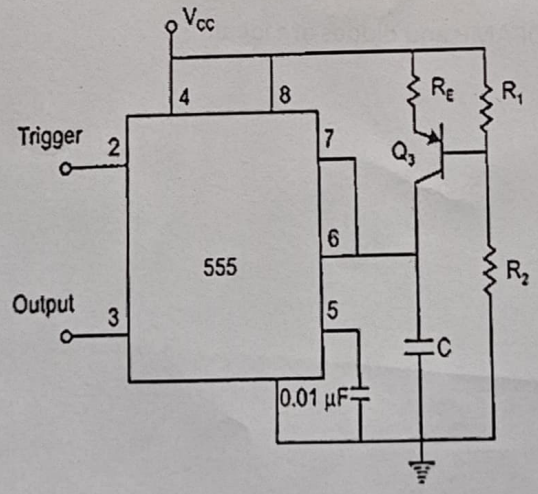

Figure 4

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