



**NBW-003-027403**    Seat No. \_\_\_\_\_

**M. Sc. (ECI) (Sem. IV) (CBCS) Examination**

**April / May - 2017**

**Paper - 15 : Op-Amp & Its Applications**

**Faculty Code : 003**

**Subject Code : 027403**

Time :  $2\frac{1}{2}$  Hours]

[Total Marks : 70

- 1 Answer the following in brief in brief : (any **seven** out of **14 ten**, each carry **two** marks)
- (1) Which of the following configuration have highest input resistance ? Explain in brief :
    - (i) Inverting configuration
    - (ii) Non-inverting configuration
    - (iii) Open-loop configuration.
  - (2) Is unity gain bandwidth product remain constant for the single break frequency Op-Amp ? Is it true for multiple break frequency Op-Amp ? Answer in brief.
  - (3) Draw a circuit diagram of compensation network for inverting amplifier Op-Amp and explain in brief.
  - (4) What is the use of  $R_{OM}$  ? Explain in brief.
  - (5) Draw a circuit diagram of zero crossing detector and output waveform for input of 1V peak to peak sine wave at 1 kHz.
  - (6) List various type of noise in Op-Amp. Why differential configuration is best suited to remove noise ? Explain in brief.
  - (7) Define various sources of an offset ? Design an Op-Amp inverting amplifier with offset compensation network having internal compensation circuitry.
  - (8) Why we use negative feedback in Op-Amp ? State the reason with suitable explanation.

- (9) Write the various applications of the Op-Amp.
- (10) How can we get 50% duty cycle in 555 astable multivibrator ? Explain in brief.

**2** Answer the following in brief : (any **two** out of **three**, each carry **seven** marks) **14**

- (1) Explain the Non-inverting amplifier using Op-Amp 741 and derive the equation for the following terms :
  - (i) Closed loop voltage gain
  - (ii) Input Resistance
  - (iii) Output resistance
  - (iv) Bandwidth with closed loop.
  - (v) Total output offset voltage with closed loop.
- (2) Explain various open-loop configuration of an op-amp with suitable diagram.
- (3) For the Op-Amp amplifier,  $R_1 = 470 \Omega$ ,  $R_F = 4.7 \text{ K}\Omega$ , assume that Op-Amp is 741 having  $A = 200,000$ ,  $R_1 = 2 \text{ M}\Omega$ ,  $R_o = 75 \Omega$ ,  $f_o = 5 \text{ Hz}$ , supply voltages =  $\pm 15 \text{ V}$ , input voltage is 1V peak to peak sine wave at 1 kHz and output voltage swing =  $\pm 13 \text{ V}$ . Calculate the values of  $A_F$ ,  $R_{iF}$ ,  $R_{oF}$  and  $V_{ooT}$ .
  - (i) For an inverting amplifier configuration
  - (ii) For a non-inverting amplifier configuration
  - (iii) Draw the waveform of input and output voltages for both configurations.
  - (iv) Conclude the result.

**3** Answer the following in brief : (each carry **seven** marks) **14**

- (1) Draw and explain the internal architecture of 555 Timer.
- (2) Write a short note on "Common mode voltage and common mode rejection ration" in the Op-Amp.

**OR**

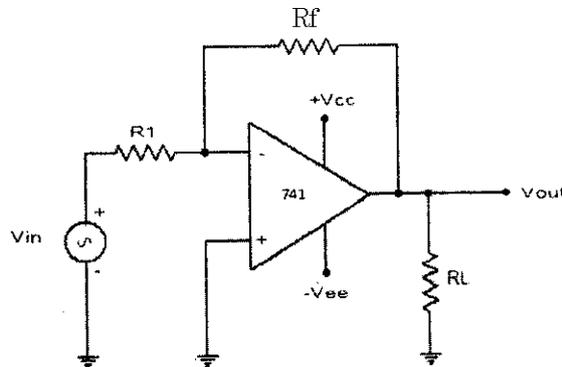
**3** Answer the following : (each carry **seven** marks) **14**

- (1) Write a short note on "slew rate" in the Op-Amp.
- (2) Draw and explain the internal architecture of 565 PLL.

4 Answer the following : (each carry **seven** marks)

14

- (1) For the inverting amplifier, determine the possible output offset voltage due to :



- (i) Input offset voltage  $V_{i0}$
- (ii) Input bias current  $I_B$
- (iii) Input offset current  $I_{i0}$
- (iv) Draw the compensation network for removing output offset voltage due to  $V_{i0}$ .
- (v) What value of  $R_{OM}$  is needed to reduce the effect of input bias current ?
- (vi) Conclude the result of above calculation.

Op-amp is type 741 with  $V_{i0} = 6\text{mv}$  DC maximum,  $I_B = 500\text{ nA}$  DC maximum at  $T_A = 25^\circ\text{C}$ ,  $I_{i0} = 200\text{ nA}$  maximum and  $V_S = \pm 15\text{V}$ .

- (2) Design the differential amplifier with one Op-Amp and two Op-Amps in brief with suitable circuit diagram. Write the difference between them.

5 Answer the following : (any **two** out of **four**, each carry **seven** marks)

14

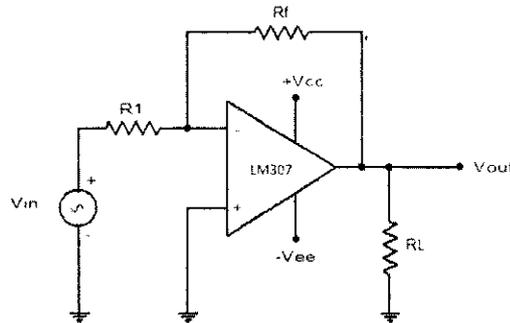
- (1) Answer the following with suitable diagram and brief explanation :
- (i) Block diagram of operational amplifier.
  - (ii) Equivalent circuit of the Op-Amp.
  - (iii) Ideal Op-Amp characteristic.
  - (iv) Ideal Voltage transfer curve.
  - (v) Gain versus frequency plot.

- (2) Refer to the inverting amplifier of the Op-Amp LM307 with the following specification :

$$\frac{\Delta V_{io}}{\Delta t} = 30 \frac{\mu\text{V}}{\text{C}} \quad \text{maximum}, \quad \frac{\Delta I_{io}}{\Delta t} = 300 \frac{\text{pA}}{\text{C}} \quad \text{maximum},$$

$V_s = \pm 15 \text{ V}$ ,  $R_1 = 1 \text{ K}\Omega$ ,  $R_F = 100 \text{ K}\Omega$  and  $R_L = 10 \text{ K}\Omega$ . Assume that the amplifier is nulled at  $25^\circ\text{C}$ .

Calculate :



- (i) Error voltage  $E_v$  and the output voltage at  $35^\circ\text{C}$  when
  - (a)  $V_{in} = 1 \text{ mV DC}$
  - (b)  $V_{in} = 10 \text{ mV DC}$ .
- (ii) Error voltage  $E_v$  and the output voltage at  $55^\circ\text{C}$  when
  - (a)  $V_{in} = 10 \text{ mV peak sine wave at } 1 \text{ kHz}$ .
  - (b) Draw the output waveform
- (iii) Conclude the result of the calculation.
- (3) Design an Op-Amp integrator circuit and explain in brief with suitable circuit diagrams.
- (4) Draw the high frequency model of Op-Amp and explain that open-loop voltage gain is a complex term which are function of frequency.