Instructions –
(1) All Questions are Compulsory.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.
(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

1. a) Attempt any SIX of the following: 12
   (i) Define:
       1) input bias current
       2) input offset current
   (ii) Draw ideal voltage transfer curve of an op-amp.
   (iii) List any four specifications of ICLM 324.
   (iv) Draw the circuit diagram of positive peak detector.
   (v) Draw voltage to current converter with grounded load.
   (vi) Define:
       1) roll-off rate
       2) order of filter
   (vii) Draw circuit of notch filter.
   (viii) State functions of following pins of IC555
       1) Threshold
       2) Discharge

P.T.O.
b) Attempt any TWO of the following:  

(i) What is the use of level shifter stage? Draw its circuit diagram.

(ii) State ideal values of following parameters of op-amp as well as state typical values of following parameters of op-amp IC741.

(iii) Draw and explain ideal voltage transfer curve of op-amp.

2. Attempt any FOUR of the following:  

a) Compare open loop and closed loop configuration of op-amp on following basis.

(i) Circuit diagram
(ii) Gain
(iii) Bandwidth
(iv) Application

b) With neat sketch derive the expression for output voltage of non-inverting averaging amplifier.

c) With neat diagram explain the concept of frequency compensation and offset nulling.

d) Draw neat diagram of active integrator and obtain expression for output voltage.

e) Determine the output voltage for an open-loop differential amplifier with \( V_1 = 1.2 \) Vdc and \( V_2 = 1 \) Vdc. Assume op-amp as \( \mu A741 \).

f) Construct and draw the circuit to get the output voltage \( V_0 = 3V_1 + 2V_2 \) where \( V_1 \) and \( V_2 \) are input voltages.

3. Attempt any FOUR of the following:  

a) Draw and explain sample and hold circuit using op-amp.

b) Compare between comparator and schmitt trigger (any four points)

c) State the needs of peak to peak detector and draw its circuit diagram.

d) State need of signal conditioning and signal processing. List any four applications of instrumentation amplifier.
e) Draw circuit diagram and input and output waveforms of inverting ZCD and non-inverting ZCD (zero crossing detector)

f) Draw and explain voltage to current converter with floating load. List its four applications.

4. Attempt any **FOUR** of the following: 16
   a) Design and draw low pass filter with cut off frequency 2kHz and passband gain of 2.
   b) Design a first order low-pass butterworth filter with a passband gain of 2 and cut-off frequency of 2kHz. Draw the designed circuit.
   c) Suggest and draw op-amp based circuit using butterworth filter to fulfill following response (Refer Figure No.1)

   ![Fig. No. 1]

   d) Describe the operation of wide bandpass filter with the help of circuit diagram.
   e) Draw only circuit of notch filter and write formula for notch frequency $f_N$.
   f) Classify the filters on following basis:
      (i) Components used
      (ii) Frequency range
      (iii) Frequency response
      (iv) Nature of passband and stopband
5. **Attempt any **FOUR** of the following:**  
   a) Describe the operation of phase detector and role of VCO in PLL.
   
   b) Draw and describe the operation of water level controller using IC555.
   
   c) Explain the use of PLL in FM detection.
   
   d) Draw the pin diagram of IC555 and explain the function of various pins.
   
   e) Explain how monostable multivibrator can be used as frequency divider.
   
   f) Draw the transfer characteristics of PLL and explain.

6. **Attempt any **FOUR** of the following:**  
   a) Draw the circuit diagram of square wave generator using IC555. State the purpose of external diode used in the circuit and state expression of its output frequency.
   
   b) Draw the circuit diagram of phase shift oscillator using IC741 state any two applications of it.
   
   c) Draw and describe the operation of astable multivibrator using op-amp.
   
   d) Design and draw Op-Amp based Wein Bridge Oscillator for frequency 1kHz.
   
   e) Explain the working of IC555 as a voltage controlled oscillator (VCO).
   
   f) Explain the working of IC555 as Schmitt trigger. Draw the circuit diagram and sketch the output waveforms.