ANALOG ELECTRONICS
(AEI2101)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) BJT can be made to operate as an amplifier by operating it in the
(a) active region (b) active and cut-off region
(c) active and saturation region (d) cut-off and saturation region

(ii) An ideal operational amplifier has
(a) zero output impedance (b) infinite input impedance
(c) infinite bandwidth (d) all of the above

(iii) Op-amp with negative feedback having
(a) high gain and less band width (b) less gain and high band width
(c) high gain and high band width (d) none of the above

(iv) A Schmitt trigger is a/an
(a) comparator without hysteresis (b) amplifier with hysteresis
(c) comparator with hysteresis (d) amplifier without hysteresis

(v) Advantage of an instrumentation amplifier is
(a) low input impedance (b) very high CMRR
(c) high output impedance (d) very low CMRR.

(vi) Recommended frequency range of Colpitts oscillator is
(a) 2Hz to 3MHz (b) 1KHz to 10MHz
(c) 0.5 KHz to 40 MHz (d) 20 KHz to 30 MHz

(vii) Wien-Bridge Oscillators generate frequencies ranging between
(a) 2Hz to 2MHz (b) 1KHz to 10MHz
(c) 20Hz to 20 KHz (d) 20 KHz to 20 MHz

(viii) In a monostable multivibrator, how many stable states are present?
(a) Three (b) Two (c) One (d) None.

(ix) What is the typical output waveform of an Astable Multivibrator?
(a) Sine wave (b) Sawtooth wave
(c) Square wave (d) Triangular wave.

(x) What is the primary function of a Voltage Controlled Oscillator (VCO)?
(a) Generate constant frequency (b) Vary frequency based on input voltage
(c) Amplify an input signal (d) Generate a constant voltage.

Fill in the blanks with the correct word

(xi) CMRR of an ideal op-amp is _____.

(xii) The Barkhausen criterion is associated with _____ feedback.

(xiii) The output of a particular Op-amp increases 8V in 12μs. The slew rate is _____.

(xiv) IC _____ is commonly used to implement a Phase-Locked Loop (PLL).

(xv) A Wien bridge Oscillator is used for generating _____.

Group - B

2. (a) What are the reasons for shifting the operating point of a transistor in an amplifier Circuit? *[(CO1)(Remember/LOCQ)]*
(b) How to achieve a stable operating point of BJT against temperature variation? Explain. *[(CO1)(Understand/LOCQ)]*
(c) What is buffer amplifier? Explain one application of buffer amplifier. *[(CO2)(Understand/LOCQ)]*

4 + 4 + 4 = 12

3. (a) Design a differential amplifier using BJT and find the output voltage in dual input balanced output mode. Identify the inverting and non-inverting input terminal. *[(CO1)(Understand/LOCQ)]*
(b) Describe the characteristics of an ideal operational amplifier. How do these characteristics differ from those of a practical operational amplifier? *[(CO2)(Remember/LOCQ)]*

(6 + 2) + 4 = 12

Group - C

4. (a) Design and explain the operation of an instrumentation amplifier. How does it differ from a standard difference amplifier? *[(CO3)(Understand/LOCQ)]*
(b) Design and explain the working principle of a Schmitt trigger circuit using an operational amplifier. Explain the concept of hysteresis and describe how it can be used to eliminate noise. *[(CO3)(Understand/LOCQ)]*

(4 + 1) + (4 + 3) = 12

5. (a) In a non-inverting positive feedback amplifier, if R_i = 10K, R_f = 56K, V_{in} =1V p-p sine wave, and the op-amp is type 741 with V_{CC}=+15V and V_{EE}=-15V. Determine the hysteresis voltage. *[(CO3)(Apply/IOCQ)]*

(b) What are the disadvantages of a theoretical active integrator circuit? Design a practical active integrator circuit to solve the above problem. Also find the range of frequency for which proper integration will take place. *[(CO3)(Understand/LOCQ)]*

4 + (2 + 2 + 4) = 12

Group - D

6. (a) Design a low-pass, active filter with cut-off frequency and pass gain as 1KHz and 10 respectively. *[(CO6)(Analyse/IOCQ)]*

(b) Explain the operation of Wien-Bridge oscillator with circuit diagram. *[(CO4)(Understand/LOCQ)]*

6 + 6 = 12

7. (a) How does an oscillator differ from an amplifier? What are the conditions required to be satisfied for an oscillator circuit? *[(CO4)(Understand/LOCQ)]*

(b) Determine the oscillation frequency of Wien bridge oscillator with neat circuit diagram. *[(CO4)(Remember/LOCQ)]*

(3 + 3) + 6 = 12

Group - E

8. (a) Explain the operation of a monostable multivibrator using operational amplifier with circuit diagram. *[(CO5)(Understand/LOCQ)]*

(b) How does a 555 timer IC work? Explain with a proper circuit diagram. *[(CO5)(Understand/LOCQ)]*

6 + 6 = 12

9. Design and explain the operation of a circuit to obtain rectangular pulse as output with duty ratio greater than 50% using IC555 timer. *[(CO5)(Apply/IOCQ)]*

(4 + 8) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	77.08	22.92	0