ANALOG ELECTRONIC CIRCUITS
(AEIE 2101)

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

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> 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)   In an Op-Amp differentiator
(a) The amplitude of output is proportional to rate of change of input
(b) Output occurs when input is finite and constant
(c) The amplitude of output is proportional to input
(d) Polarity of input and output is the same

(ii)   A BJT can be made to operate as an amplifier by operating it in the _____ region(s).
(a) Active   (b) Cut-off
(c) Saturation   (d) Cut-off and saturation

(iii)   The gain of a transistor amplifier falls at low frequencies due to the
(a) Internal Capacitance of the device   (b) Coupling capacitor at the input
(c) Skin effect   (d) None of the above

(iv)   A Hartley oscillator circuit has _____ inductor(s) and ____ capacitor(s)
(a) 1 and 2   (b) 1 and 1
(c) 2 and 2   (d) 2 and 1

(v)   Which of the following electrical characteristics is not exhibited by an ideal op-amp?
(a) Infinite voltage gain   (b) Infinite bandwidth
(c) Infinite output resistance   (d) Infinite CMRR.

(vi)   An op-amp circuit that uses a resistance in series with input and capacitor in the feedback path is called as a/an _____ amplifier.
(a) Integrator   (b) Differentiator
(c) Logarithmic   (d) Antilogarithmic

(vii)   Schmitt trigger is a
(a) Comparator with hysteresis   (b) Amplifier with hysteresis
(c) Rectifier   (d) Filter

(viii) Common mode gain of an ideal op-amp is
(a) 1   (b) 0   (c) -1   (d) ∞

(ix) Wien-Bridge Oscillators generate frequencies ranging between
(a) 20 Hz – 20 KHz   (b) 20 KHz – 20 MHz
(c) 20 MHz – 20 GHz   (d) Any frequency range.

(x) An astable multivibrator generates
(a) Triangular waveform   (b) Square waveform
(c) Ramp waveform   (d) Sawtooth waveform.

Fill in the blanks with the correct word

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

(xii) Differential gain of an ideal op-amp is _____.

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

(xiv) An oscillator is associated with _____ feedback.

(xv) A differentiator circuit is basically a _____ filter.

Group - B

2. (a) How to achieve a stable operating point of a BJT amplifier against temperature variation? Explain.
                                                               [(CO1)(Understand /LOCQ)]
   (b) Design and explain the operation of a differential amplifier circuit using BJT.
                                                    [(CO2) (Understand/LOCQ)]
   6 + (2 + 4) = 12

3. (a) Design an open loop comparator to compare a reference value of -1V with a 4V p-p sinusoid signal. Draw the output waveform and find Duty ratio.
                                                      [(CO3)(Create/HOCQ)]
   (b) Explain the operation of an Instrumentation amplifier. What are the advantages of this amplifier?
                                                   [(CO3) (Understand/LOCQ)]
   (2 + 2 + 2) + (4 + 2) = 12

Group - C

4. (a) Find out the output voltage of the given circuit.

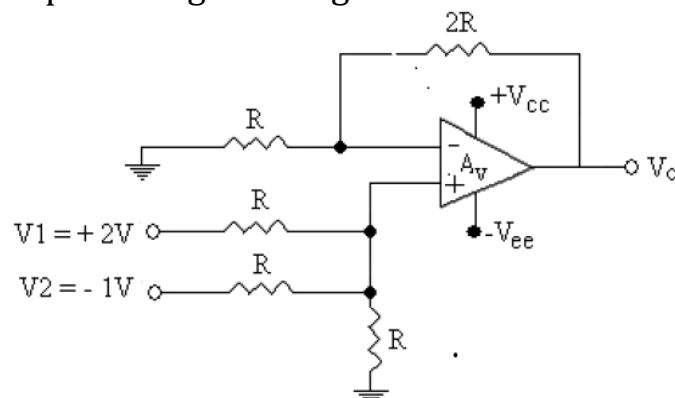

Fig. 1

                                                      [(CO6)(Evaluate/HOCQ)]

(b) What is the necessity of the precision rectifier? Explain the operation of a half wave precision rectifier with neat circuit diagram. *[(CO3) (Understand/LOCQ)]*

6 + 6 = 12

5. (a) Construct and Explain the operation of the circuit of which output voltage is an exponential function of the input voltage. *[(CO3) (Understand/LOCQ)]*

(b) Define input bias current, input offset voltage, and slew rate.

[(CO3)(Remember/LOCQ)]

6 + (2 + 2 + 2) = 12

Group - D

6. (a) Design a circuit to generate triangular wave using square wave as input signal.

[(CO6) (Create/HOCQ)]

(b) Compare Colpitts and Hartley oscillators with respect to their feedback components. Which of the different types of oscillators provides the most stable oscillation frequency? *[(CO4)(Analyze/IOCQ)]*

7 + (3 + 2) = 12

7. (a) Design a high- pass, active filter with cut-off frequency and pass gain as 100 Hz and 10 respectively. *[(CO6) (Create/HOCQ)]*

(b) In a 3- stage RC-phase shift oscillator, each RC combination has Resistive value as 200 KΩ and Capacitive values as 100 pF, evaluate the frequency of oscillation.

[(CO4) (Evaluate/HOCQ)]

6 + 6 = 12

Group - E

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

(b) In a non-inverting positive feedback amplifier, if R_i = 1000K, R_f = 56K, V_{in} =1V pp sine wave, and the op-amp is type 741 with V_{CC}=+15V and V_{EE}=-15V. Determine the hysteresis voltage. *[(CO6) (Evaluate/HOCQ)]*

6 + 6 = 12

9. (a) How does an oscillator differ from an amplifier? *[(CO4)(Understand/LOCQ)]*

(b) Classify the multivibrators in terms of their operational characteristics.

[(CO5) (Understand/LOCQ)]

(c) How does a 555 timer IC work? Explain with a proper diagram.

[(CO5)(Analyze/IOCQ)]

3 + 3 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	50	11.46	38.54

Course Outcome (CO):

After the completion of the course students will be able to
1. Apply the knowledge of semiconductor fundamentals to analyze simple electronic circuits based on diodes and transistors with special focus on designing different biasing methods of BJT.
2. Design and analyze BJT amplifiers for small and large signal.
3. Learn basic function of operational amplifier, ideal and practical characteristics and their mathematical applications.
4. Design and compare between different types of Oscillators to meet the specified needs with appropriate consideration.
5. Design, analyze and understand the application of different types of multivibrators with and without IC 555.
6. Analyze and design analog electronic circuits using discrete components with specified needs for enhancement of knowledge.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.