ANALOG CIRCUITS
(ECEN 2101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The slope of the load line depends on
(a) type of the diode used (b) characteristic curve
(c) load resistor (d) source voltage.

(ii) A circuit that removes positive or negative part of an ac signal is called
(a) Clipper (b) Clamper
(c) Amplifier (d) Oscillator

(iii) Maximum power efficiency that can be achieved by Class A power amplifiers is
(a) 25% (b) 78.5% (c) 50% (d) 30%.

(iv) Which one of the following oscillator is used for the generation of high frequencies?
(a) R-C phase-shift (b) L-C oscillator
(c) Wien-bridge (d) none of the above.

(v) A zero-crossing detector is an application of a
(a) Differentiator (b) Integrator
(c) Summing Amplifier (d) Comparator.

(vi) The best frequency stability is obtained by using
(a) Colpitts oscillator (b) Hartley oscillator
(c) Wien Bridge oscillator (d) Crystal oscillator.

(vii) In an ideal op-amp, which is not true?
(a) Open loop voltage gain is infinite (b) Input resistance is infinite
(c) Slew rate is infinite (d) CMRR is zero.

(viii) In a Common Base BJT based circuit, for a fixed emitter base junction forward bias, increase in reverse bias across the collector base junction,
(a) increases emitter current (b) decreases emitter current
(c) keeps emitter current constant (d) makes emitter current zero

(ix) In an LC oscillator, the frequency of oscillator is …….. L or C.
(a) Proportional to square of
(b) Directly proportional to
(c) Independent of the values of
(d) Inversely proportional to square root of

(x) Crossover distortion can be observed in
(a) class-AB amplifier (b) class-A amplifier
(c) class-B amplifier (d) class-C amplifier.

Group- B

2. (a) Why is the stability of Q point essential? Derive the stability factor (with respect to I_{CO}) for a collector to base bias circuit. [(CO2) (Remember/LOCQ)]

(b) In the fixed bias circuit as shown in Fig.1. V_{CC}=15V, R_C=2 kΩ, R_B=300 kΩ, β=100, V_{BE}=0.7V. Neglect I_{CO}. Determine
(i) Base current I_B
(ii) The quiescent point

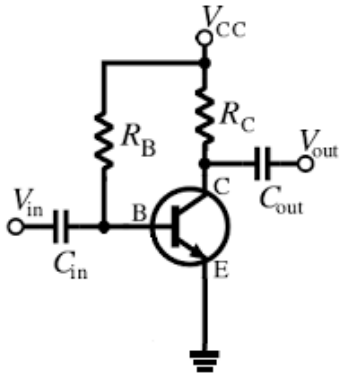

Fig.1

[(CO2)(Apply/IOCQ)]

(2 + 4) + (2 + 4) = 12

3. (a) Draw the hybrid parameter model of a bipolar junction transistor. Define the four hybrid parameters. [(CO2)(Remember/LOCQ)]

(b) The input signal v_i is a sinusoid having an amplitude of 10V, V_{B1}=8V and V_{B2}=6V. Draw the output voltage waveform v_o. Diodes D_1 and D_2 are ideal.

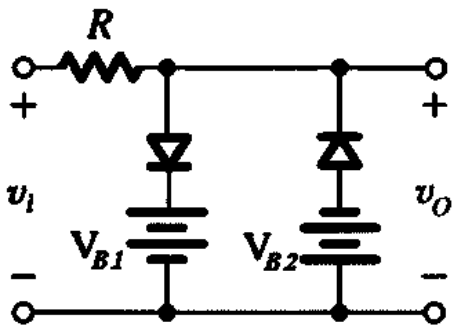

Fig.2

[(CO1) (Evaluate/HOCQ)]

(c) Using the small signal model of BJT, derive expressions of input impedance Z_i, and voltage gain A_v of a fixed bias amplifier circuit. [(CO3)(Analyse/IOCQ)]

4 + 4 + 4 = 12

Group - C

4. (a) A Wien Bridge oscillator has a frequency of oscillation1 kHz and a capacitance of 100pF. Find the value of resistance required. [(CO4) (Create/HOCQ)]

   (b) Sketch the circuit diagram of a Phase shift oscillator. Calculate the frequency of the oscillation and the condition for sustained oscillation. [(CO4)(Analyse/IOCQ)]

4 + 8 = 12

5. (a) What is the effect of negative feedback on the output impedance of voltage-series feedback amplifier? [(CO4) (Remember/LOCQ)]

   (b) Determine voltage gain, input and output impedance for voltage shunt feedback having A=-120, R_i=2.2 kΩ, R_o=22 kΩ and β=-0.1. [(CO4) (Analyse/IOCQ)]

   (c) Sketch the circuit diagram of a Hartley oscillator. If the parameters of the oscillator are: L_1=500μH, L_2=5mH, M= 300μH, C=150pF. Find the frequency of oscillation. [(CO4) (Evaluate/HOCQ)]

3 + 3 + (3 + 3) = 12

Group - D

6. (a) Explain the operation of an instrumentation amplifier with proper circuit diagram. [(CO5) (Remember/LOCQ)]

   (b) Design and draw the circuit for following operation using op - amp.: $V_0 = V_1 + V_2 - 2V_3$ where V_1, V_2 , $V_3$are input voltage signals and V_0 is the output voltage signal. [(CO5) (Create/HOCQ)]

   (c) Draw the circuit diagram of a Schmitt trigger circuit. [(CO5)(Remember/LOCQ)]

6 + 4 + 2 = 12

7. (a) In the Fig. 3. If V_1=0.5V and V_2=0.1V, find V_o.

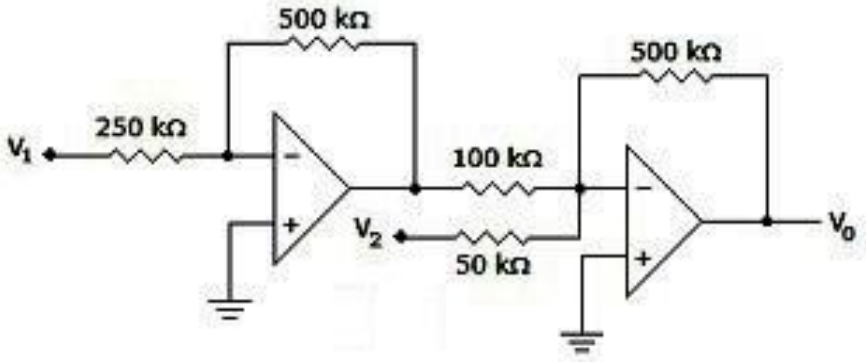

Fig.3

[(CO5) (Apply/IOCQ)]

   (b) Draw the circuit diagram of a half wave Precision rectifier circuit. [(CO5) (Remember/LOCQ)]

   (c) What is a current mirror and why is it called so? Explain with proper circuit diagram the working of current mirror. [(CO5)(Analyse/IOCQ)]

4 + 2 + (2 + 4) = 12

Group - E

8. (a) A class B push pull power amplifier is supplied with Vcc=50 V. The signal swings the collector voltage down to Vmin=5V. The total dissipation in both transistors is 40 W. Find the total power and conversion efficiency. [(CO6) (Apply/IOCQ)]
   (b) Draw the circuit diagram of a push pull amplifier. List the advantages of the circuit. [(CO6) (Remember/LOCQ)]
   (c) What is cross over distortion? [(CO6)(Understand/LOCQ)]

4 + (4 + 2) + 2 = 12

9. (a) Draw the circuit diagram and explain the operation of a monostable multivibrator using a 555 timer IC. Derive the expression for output pulse width. [(CO4) (Analyse/IOCQ)]
   (b) Determine the frequency and duty cycle for 555 Astable multi-vibrator output for C=0.01 μF, R_A=2 kΩ and R_B=100 kΩ.

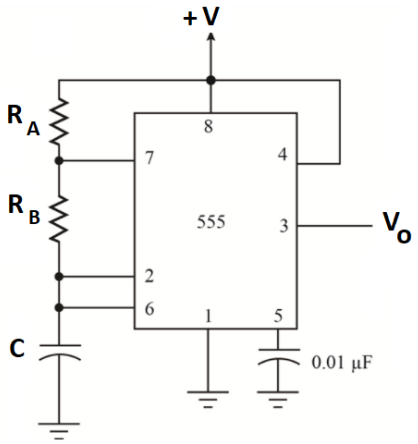

Fig.4

[(CO4) (Evaluate/HOCQ)]

(6 + 2) + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32%	45%	23%

Course Outcome (CO):

After the completion of the course students will be able to

1. Apply the previous knowledge gathered from Basic Electrical and Basic Electronics papers.
2. Understand the concepts of BJT, MOSFET and biasing techniques of BJT and MOSFET based amplifier circuits.
3. Analyse frequency response of amplifier circuits.
4. Design different types sinusoidal oscillators and multivibrator circuits.
5. Construct algebraic equation-based amplifier and analog computers using OP-AMP
6. Design stable high-gain amplifier circuits.

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

Department & Section	Submission Link
CSE A	https://classroom.google.com/u/0/w/NDA1MTI0NjA5Mjg0/tc/NDY4MDA0NTc1NzI4
CSE B	https://classroom.google.com/u/0/w/NDA0OTUzODA2MDY2/tc/NDc1MTUyODE2MTg0
CSE C	https://classroom.google.com/c/NDA1MTk5NjAxMzQz/a/NDc1MTUwNzQxNTU5/details
ECE A	https://classroom.google.com/w/NDA1Mjk2MTM3OTI2/tc/NDc0ODUyMTUwODE0
ECE B	https://classroom.google.com/c/NDA1MTk2NjIwMTI5/a/NDc0ODU1MDAwNjQy/details
ECE C	https://classroom.google.com/c/NDA1MzQyNTU4NDkz/a/NDc1MTUwMzAyMzI4/details
IT	https://classroom.google.com/w/NDQyMjEzNzM4MDY1/tc/NDc3MzIyOTM5Njgx