BASIC ELECTRONICS
(ECEN 1011)

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) Avalanche breakdown is primarily dependent on the mechanism of
(a) doping (b) collision
(c) ionization (d) recombination

(ii) By which process impurity is added to an intrinsic semiconductor?
(a) Doping (b) Recombination
(c) Atomic modification (d) Ionization

(iii) Where most of the holes in the base of a PNP transistor flow?
(a) Into the collector (b) Into the emitter
(c) Into the supply (d) Out of base

(iv) What is the effect of negative feedback in an amplifier?
(a) Reduces the voltage gain
(b) Increases the voltage gain
(c) Does not affect the voltage gain
(d) Can convert it into an oscillator if the amount of feedback is enough

(v) What should be the gain of an ideal OP-AMP?
(a) Zero (b) Unity
(c) Infinity (d) Unpredictable

(vi) If both junction of transistor operated in reversed biased then transistor operated in
(a) Cut off region (b) Active region
(c) inverted region (d) saturation region

(vii) The ripple factor of half wave and full wave rectifier are
(a) 1.11 and 0.48 (b) 0.49 and 1.12
(c) 1.21 and .81 (d) 1.21 and 0.48

(viii) For a step input, the output of integrator is a
(a) pulse (b) triangular waveform
(c) spike (d) ramp

(ix) Temperature coefficient of Zener breakdown voltage
(a) Negative (b) Positive
(c) has no effect (d) None of these

(x) What is the polarityof the Gate Threshold Voltage in a n-channel enhancemement type MOSFET?
(a) Positive (b) Negative
(c) Can be positive or negative (d) Zero.

Group- B

2. (a) Differentiate between metals, insulators and semiconductors w.r.t. band gap. [(CO1) (Analyze/IOCQ)]
(b) Explain the energy band of intrinsic and extrinsic semiconductors with suitable diagrams. [(CO1) (Understand/LOCQ)]
(c) At 300K, the intrinsic carrier concentration of silicon is $2.5x10^{16}m^{-3}$. Calculate the intrinsic resistivity of silicon, if electron and hole mobilities are $0.13m^2/V.s$ and $0.05m^2/V.s$ respectively. [(CO1)(Evaluate/HOCQ)]
(d) Explain the I-V characteristics of a p-n junction diode. [(CO2) (Understand/LOCQ)]

2 + 4 + 3 + 3 = 12

3. (a) Differentiate between Zener breakdown and Avalanche breakdown mechanisms. [(CO2) (Analyze /IOCQ)]
(b) Explain (i) mass-action law (ii) diffusion current. [(CO1) (Understand/LOCQ)]
(c) A full-wave rectifier uses a double diode, the forward resistance of each element being 200 ohm. The rectifier supplies current to a load resistance of 1000 ohm. The primary-to-total secondary turns ratio of the centre-tapped transformer is 1:3. The transformer primary is fed from a supply of 240V (rms). Evaluate (i) dc load current (ii) dc power output (iv) ripplevoltage across load resistance (v) the percentage regulation and (vi) rectification efficiency. [(CO3)(Evaluate/HOCQ)]

3 + 3 + 6 = 12

Group - C

4. (a) Explain (i) Early effect (ii) Punch through in BJT. [(CO4)(Understand /LOCQ]
(b) Explain the input and output characteristics of BJT in CE mode. [(CO4)(Understand/LOCQ]
(c) A transistor having $\alpha = 0.975$ and a reverse saturation current $I_{CO}=10\mu A$ is operated in CE configuration. Evaluate β for this configuration? If the base current is 250 μA, evaluate the emitter current and the collector current. [(CO4)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

5. (a) Explain (i) Q-point of BJT (ii) Thermal runaway. [(CO4) (Understand /LOCQ]

(b) An npn transistor is used as CE amplifier and has collector-to-base bias arrangement as shown in Fig.1

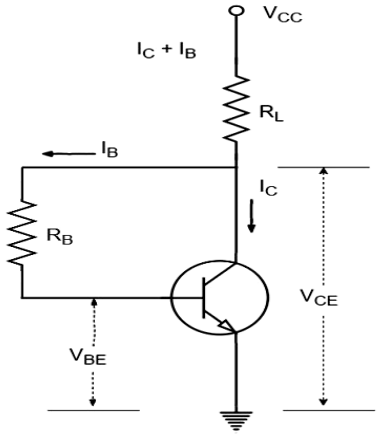

Fig. 1

Given V_{BE}=0.7V, V_{CC}=12V, R_L=2 kΩ, R_B=100kΩ. Evaluate I_C,I_B and V_{CE} and stability factor S. [(CO4)(Evaluate/HOCQ)]

4 + 8 = 12

Group - D

6. (a) Distinguish between enhancement type and depletion type MOSFET? [(CO5) (Understand/LOCQ)]

(b) " A BJT is a current-controlled device while a FET is a voltage-controlled device". Justify. [(CO5) (Evaluate/IOCQ)]

(c) Why is the field-effect transistor called a unipolar transistor? Show the circuit symbol of JFET. [(CO5)(Remember, Understand/IOCQ)]

4 + 4 + (2 + 2) = 12

7. (a) Differentiate between enhancement type and depletion type MOSFET. [(CO5) (Analyze/IOCQ)]

(b) Explain threshold voltage of MOSFET? [(CO5) (Understand/LOCQ)]

(c) Design a NAND gate using CMOS. [(CO6) (Analyze/IOCQ)]

3 + 2 + 7 = 12

Group - E

8. (a) Explain with the help of a block diagram the working principle of a feedback amplifier. Find out an expression for the voltage gain with feedback. [(CO5) (Understand/LOCQ)]

(b) Evaluate the output voltage V_o of the three input summing amplifier circuit given below in Fig 2.

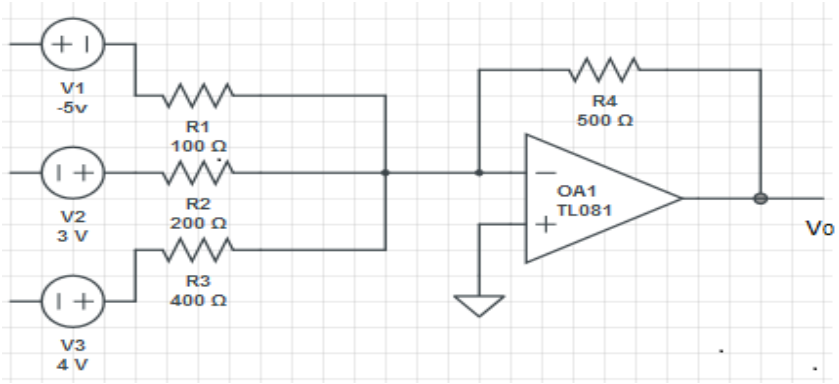

Fig.2

[(CO5) (Evaluate/HOCQ)]

(c) An amplifier has the voltage gain of – 500. This gain is reduced to –100 when negative feedback is applied. Evaluate (i) the feedback factor β (ii) the amount of feedback in dB, (iii) the output voltage of the feedback amplifier for an input voltage of 40 mV. [(CO5) (Evaluate/HOCQ)]

4 + 4 + 4 = 12

9. (a) Explain the characteristics of an ideal OP-AMP. [(CO5) (Understand/LOCQ)]
   (b) Explain the operation principle of Silicon Controlled Rectifier. [(CO6) (Understand/LOCQ)]
   (c) Explain the operation of differentiator using a non-inverting amplifier. [(CO5) (Understand/LOCQ)]

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45.83%	28.13%	26.04%

Course Outcomes (CO):

After the completion of the course students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input.

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

Department & Section	Submission Link
BT	https://classroom.google.com/w/NDA1NTk4NDY3MDgy/tc/NDc3NzMwMzI5MTIx
CE	https://classroom.google.com/w/NDAxMTg4NzAzMDkw/tc/NDYyMzkzMDE5OTkz
CHE	https://classroom.google.com/u/0/w/NDA1NjMxNTQ4OTg2/tc/NDc0ODUyOTAzNDQy
CSE(AI&ML)	https://classroom.google.com/c/NDE1NjQ4Nzg1Mzgy/a/NDc1MTYwMTEwNjM0/details
CSE(DS)	https://classroom.google.com/u/0/w/NDA1Mzc1Mzg1MjA5/tc/MjI3ODg5Njg5ODMz
EE	https://classroom.google.com/w/NDA2MDQxNTYzMDI3/tc/NDc3NTI3MTIzODA4
ME	https://classroom.google.com/w/NDA1NjA3Mzc0Njcy/tc/NDc0ODUwMDI4ODA2
BACKLOG	https://classroom.google.com/c/NDA1NjA3Mzc0Njcy?cjc=kg7abln