

**ECE 101**

**B.TECH. II<sup>nd</sup> SEMESTER EXAMINATION, 2023-24**

**B.TECH.**

**(Basic Electronics Engineering)**

**(CSE, ME)**

**(CBCS Mode)**

AFFIX PRESCRIBED  
RUBBER STAMP

Date (तिथि) : 15/05/2024

**Paper ID**

(To be filled in the  
OMR Sheet)

**6035**

अनुक्रमांक (अंकों में) :

Roll No. (In Figures) :

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अनुक्रमांक (शब्दों में) :

Roll No. (In Words) :

**Time : 1:30 Hrs.**

**समय : 1:30 घण्टे**

**Max. Marks : 75**

**अधिकतम अंक : 75**

**नोट : पुस्तिका में 50 प्रश्न दिये गये हैं, सभी प्रश्न करने होंगे। प्रत्येक प्रश्न 1.5 अंक का होगा।**

**Important Instructions :**

1. The candidate will write his/her Roll Number only at the places provided for, i.e. on the cover page and on the OMR answer sheet at the end and nowhere else.
2. Immediately on receipt of the question booklet, the candidate should check up the booklet and ensure that it contains all the pages and that no question is missing. If the candidate finds any discrepancy in the question booklet, he/she should report the invigilator within 10 minutes of the issue of this booklet and a fresh question booklet without any discrepancy be obtained.

**महत्वपूर्ण निर्देश :**

1. अभ्यर्थी अपने अनुक्रमांक केवल उन्हीं स्थानों पर लिखेंगे जो इसके लिए दिये गये हैं, अर्थात् प्रश्न पुस्तिका के मुख्य पृष्ठ तथा साथ दिये गये ओ०एम०आर० उत्तर पत्र पर, तथा अन्यत्र कहीं नहीं लिखेंगे।
2. प्रश्न पुस्तिका मिलते ही अभ्यर्थी को जाँच करके सुनिश्चित कर लेना चाहिए कि इस पुस्तिका में पूरे पृष्ठ हैं और कोई प्रश्न छूटा तो नहीं है। यदि कोई विसंगति है तो प्रश्न पुस्तिका मिलने के 10 मिनट के भीतर ही कक्ष परिप्रेक्षक को सूचित करना चाहिए और बिना त्रुटि की दूसरी प्रश्न पुस्तिका प्राप्त कर लेना चाहिए।

1. In an intrinsic semiconductor, the free electron concentration depends on :
  - (A) The effective mass of electrons only
  - (B) The effective mass of holes only
  - (C) Temperature
  - (D) Width of the forbidden energy gap of the semiconductor
2. Two semiconductors have exactly the same properties except that the material A has a band gap of 1.5eV and material B has a bandgap of 1.7eV. The ratio of intrinsic concentration of material A to material B at 300K is :
  - (A) 44.5
  - (B) 45.5
  - (C) 46.5
  - (D) 47.5
3. In an n-type semiconductor, as temperature T increases, the fermi level :
  - (A) Moves towards conduction band
  - (B) Moves towards the middle of the forbidden energy gap
  - (C) Does not shift
  - (D) Shifts depending on the concentration of donor atoms
4. Depletion layer width \_\_\_\_\_ under \_\_\_\_\_ condition and \_\_\_\_\_ under \_\_\_\_\_ condition.
  - (A) Decreases, forward biased, increases, reverse biased
  - (B) Increases, forward, biased, decreases, reverse biased
  - (C) Decreases, reverse biased, increases, forward biased
  - (D) None of the above
5. When used in a circuit, a zener diode is always :
  - (A) Forward biased
  - (B) Connected in series
  - (C) Troubled by overheating
  - (D) Reverse biased

6. The doping concentrations of an n-p-n transistor are :

(a)  $5 \times 10^{18} \text{ cm}^{-3}$

(b)  $2 \times 10^{17} \text{ cm}^{-3}$

(c)  $10^{17} \text{ cm}^{-3}$

Identify the base, emitter and collector regions in order :

(A) a, b, c

(B) b, a, c

(C) c, a, b

(D) a, c, b

7. For the emitter-base junction width  $J_E$  and base-collector junction width  $J_C$ , which of the following statement is correct ?

(A)  $J_E = J_C$

(B)  $J_C > J_E$

(C)  $J_E > J_C$

(D)  $J_E = 0, J_C$  large value

8. Match the various modes in BJT :

Mode	Bias
(a) Reverse Active	1. EB Forward CB Forward
(b) Cut-off	2. EB Reverse CB Forward
(c) Saturation	3. EB Forward CB Reverse
(d) For ward Active	4. EB Reverse CB Reverse

(a) (b) (c) (d)

(A) 1 2 3 4

(B) 4 2 1 3

(C) 2 4 1 3

(D) 3 2 4 1

9. For a BJT, under the saturation condition :

(A)  $I_C = \beta I_B$

(B)  $I_C > \beta I_B$

(C)  $I_C$  is independent of all other parameters

(D)  $I_C < \beta I_B$

10. The phenomenon known as "Early Effect" in BJT refers to a reduction of the effective base width caused by :

(A) Electron-hole recombination at the base

(B) The reverse biasing of the base collector junction

(C) The forward biasing of the emitter base junction

(D) The early removal of stored base charge during saturation to cutoff switching

11. The unique features to a CC amplifier circuit is that it :

(A) Steps up impedance levels

(B) Does not increase signal voltage

(C) Acts as an impedance matching device

(D) All the above

12. To avoid thermal runaway in the design of an analog circuit, the operating point of the BJT should be such that it satisfies the condition :

(A)  $V_{CE} = \frac{1}{2} V_{CC}$

(B)  $V_{CE} \leq \frac{1}{2} V_{CC}$

(C)  $V_{CE} \geq \frac{1}{2} V_{CC}$

(D)  $V_{CE} \leq 0.78 V_{CC}$

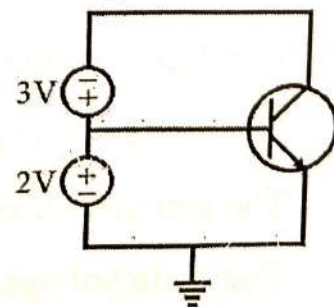
13. The region of operation for the transistor shown in the figure below is :

(A) Active

(B) Cut-off

(C) Inverse active

(D) Saturation



14. The dc load line of a transistor circuit :
- (A) Has a negative slope
  - (B) Is a curved line
  - (C) Gives graphic relation between  $I_C$  and  $I_B$
  - (D) Does not contain the Q-point
15. When a BJT is employed as an amplifier it operates :
- (A) In cut off
  - (B) In saturation
  - (C) Well into saturation
  - (D) Over the active region
16. JFET model has a :
- (A) Voltage controlled voltage source
  - (B) Current controlled voltage source
  - (C) Voltage controlled current source
  - (D) Current controlled current source
17. The advantage of JFET over BJT is :
- (A) Low noise
  - (B) High input impedance
  - (C) High GBW product
  - (D) Current controlled behaviours
18. The Pinch-off voltage in a FET is :
- (A) The drain voltage that gives zero drain current
  - (B) The gate-to-source voltage that gives unity drain current
  - (C) The gate-to-source voltage that gives zero drain current
  - (D) The drain voltage that gives infinite drains current

19.  $V_P$ , is the pinch-off voltage for  $V_{GS} = 0$  in a FET. When the gate is reverse biased by  $V_{GS}$ , the pinch-off voltage :
- (A) Will be less than  $V_P$
- (B) Will be more than  $V_P$
- (C) Same as  $V_P$
- (D) Does not depend on  $V_P$
20. Two identical FETs are characterized by the parameters  $g_m$  and  $r_d$ . The characteristic parameters for a parallel combination of two FETs are :
- (A)  $g_m/2$  and  $2r_d$
- (B)  $2g_m$  and  $r_d/2$
- (C)  $g_m/2$  and  $r_d/2$
- (D)  $2g_m$  and  $2r_d$
21. For an n-channel JFET,  $V_P = -4V$ ,  $I_{DSS} = 10mA$  and output resistance in saturation is infinite. Find  $I_D$  for  $V_{GS} = -2V$  and  $V_{DS} = 3V$  :
- (A) 1.5 mA
- (B) 2.0 mA
- (C) 2.5 mA
- (D) 3 mA
22. MOSFET uses the electric field of :
- (A) Gate capacitance to control the channel current
- (B) Barrier potential of a p-n junction to control the channel current
- (C) Both
- (D) None of the above
23. MOSFET can be used as a :
- (A) Current controlled capacitor
- (B) Voltage controlled capacitor
- (C) Current controlled inductor
- (D) Voltage controlled inductor

24. The threshold voltage of a MOSFET can be lowered by :

- (i) Using a thinner gate oxide
- (ii) Reducing the substrate concentration
- (iii) Increasing the substrate concentration
- (A) (iii) alone is correct
- (B) (i) and (ii) are correct
- (C) (i) and (iii) are correct
- (D) (ii) alone is correct

25. MOSFET<sub>s</sub> can be operates at higher frequencies compared to BJT<sub>s</sub> because :

- (A) MOSFET<sub>s</sub> have higher input impedance
- (B) MOSFET<sub>s</sub> are voltage controlled
- (C) MOSFET<sub>s</sub> have positive temperature coefficient
- (D) Minority carrier storage time is absent in MOSFET<sub>s</sub>

26. The drain of an n-channel MOSFET is shorted to the gate so that  $V_{GS} = V_{DS}$ . The threshold voltage ( $V_T$ ) of MOSFET is 1V. If the drain current ( $I_D$ ) is 1 mA for  $V_{GS} = 2V$ , than for  $V_{GS} = 3V$ ,  $I_D$  is :

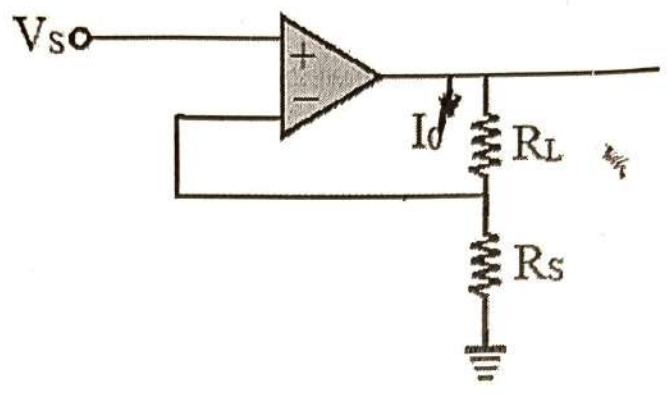
- (A) 2 mA
- (B) 3 mA
- (C) 9 mA
- (D) 4 mA

27. The effective channel length of a MOSFET in saturation decreases with increase in :

- (A) Gate Voltage
- (B) Drain Voltage
- (C) Source Voltage
- (D) Body Voltage

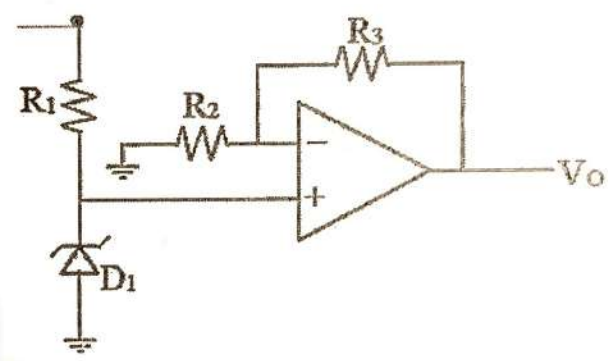
28. In the circuit shown  $I_0$  is given by :

- (A)  $\frac{V_S R_L}{R_S (R_L + R_S)}$
- (B)  $\frac{V_S}{R_S}$
- (C)  $\frac{V_S}{R_L}$
- (D)  $V_S \left( \frac{1}{R_S} + \frac{1}{R_L} \right)$



29. The circuit is that of :

- (A) Inverting type reference voltage
- (B) Non-inverting type reference voltage
- (C) A logarithmic amplifier
- (D) An antilog amplifier

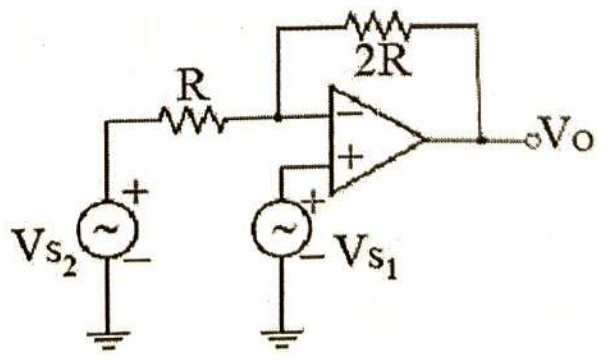


30. For an ideal difference amplifier, the common mode rejection ratio (CMRR) should be :

- (A) As high as possible
- (B) As low as possible
- (C) Constant
- (D) None of the above

31. In the op-amp circuit shown,  $V_0$  is given by :

- (A)  $3 V_{S_1} - 6 V_{S_2}$
- (B)  $2 V_{S_1} - 3 V_{S_2}$
- (C)  $2 V_{S_1} - 2 V_{S_2}$
- (D)  $3 V_{S_1} - 2 V_{S_2}$



32. A half-wave rectified sinusoidal waveform has a peak voltage of 10.V Its average value and the rms value of the fundamental components are, respectively given by :

(A)  $\frac{20}{\pi} V, \frac{10}{\sqrt{2}} V$

(B)  $\frac{16}{\pi} V, \frac{10}{\sqrt{2}} V$

(C)  $\frac{10}{\pi} V, 5 V$

(D)  $\frac{20}{\pi} V, 5 V$

33. The Hall coefficient  $R_H$  is defined by :

(A)  $R_H = \frac{V_H W}{B}$

(B)  $R_H = \frac{L_H B}{IW}$

(C)  $R_H = \frac{V_H W}{I}$

(D)  $R_H = \frac{V_H \cdot W}{B \cdot I}$

34. A major advantage of an emitter follower is that it provides :

(A) Maximum gain

(B) Maximum efficiency

(C) Maximum output impedance

(D) Minimum distortion

35. Consider an n-channel MOSFET with  $t_{ox} = 20nm$ ,  $\mu_n = 650 cm^2/V_s$ ,  $V_t = 0.8v$  and  $W/L=10$ . Find the drain current for  $V_{as} = V_{DS} = 5V$ . (Given  $\epsilon_{ox} = 3.45 \times 10^{-11} F/m$ ) :

(A) 4.15 mA

(B) 0.92 mA

(C) 9.9 mA

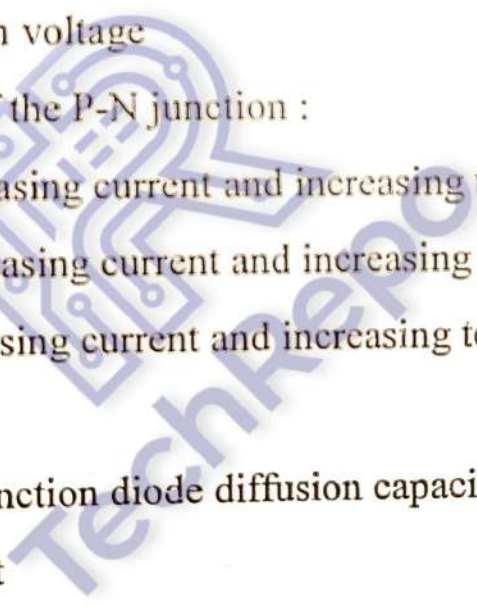
(D) None of the above

36. Electron mobility and lifetime in a semiconductor at 300K are  $3600 \text{ cm}^2/\text{Vs}$  and  $340 \mu\text{s}$ , respectively. The diffusion length is :
- (A) 3.13 cm  
 (B) 1.77 cm  
 (C) 1.77 mm  
 (D) 3.13 mm
37. Silicon is preferred for manufacturing zener diodes because it :
- (A) Is relatively cheap  
 (B) Needs lower doping levels  
 (C) Has higher temperature and current capacity  
 (D) Has lower breakdown voltage
38. The diffusion capacitance of the P-N junction :
- (A) Decreases with increasing current and increasing temperature  
 (B) Decreases with decreasing current and increasing temperature  
 (C) Increases with increasing current and increasing temperature  
 (D) None of the above
39. For a forward biased P-N junction diode diffusion capacitance varies :
- (A) Linearly with current  
 (B) Square of current  
 (C) Inversely with current  
 (D) Does not vary with current
40. The fermi level of a heavily doped n-type semiconductor lie in the :
- (A) Valence Band  
 (B) Conduction Band  
 (C) Middle of the bandgap  
 (D) None of the above

Handwritten calculations for Q36:  
 $3600 \times 340 \times 10^{-6}$   
 $1224 \times 10^{-3}$   
 $1.224$   
 $1.77$

Handwritten calculations for Q36:  
 $3600 \times 340$   
 $1224000$   
 $1224$

Handwritten notes for Q38:  
 $C_D = \tau I$   
 $C_D \propto I$   
 $C_D \propto T$



41. The unit of a ratio of mobility to diffusion constant :
- (A)  $1/k$
  - (B)  $1/v$
  - (C)  $1/kv$
  - (D)  $1/ev$
42. A semiconductor is doped with  $10^{15}$  phosphorus atoms/cc. The intrinsic carrier concentration is  $10^{10}/cc$ . The approximate number of holes in the doped semiconductor under equilibrium is :
- (A)  $10^5$
  - (B) 0
  - (C)  $10^{10}$
  - (D)  $10^{15}$
43. Measurement of Hall coefficients enables the determination of :
- (A) Mobility of charge carriers
  - (B) Type of conductivity and concentration of charge carriers
  - (C) Both
  - (D) None of these
44. The material which is not a semiconductor is :
- (A) Selenium
  - (B) Gallium Arsenide
  - (C) Silica
  - (D) Carborundium
45. In a semiconductor under high electric field, with increasing electric field :
- (A) Mobility decreases
  - (B) Mobility increases
  - (C) Velocity saturates
  - (D) Velocity increases

46. In the energy band diagram of a p-type semiconductor :
- (A) The acceptor band is near the conduction band ✓
  - (B) The acceptor band is near the valence band
  - (C) The donor band is near the valence band ✓
  - (D) The donor band is near the conduction band
47. Hall voltage is proportional to :
- (A) Velocity
  - (B) Magnetic field
  - (C) Both (A) and (B) and parallel to the velocity
  - (D) Both (A) and (B) and perpendicular to the voltage
48. Consider two energy levels :  $E_1, E_2$  eV above the Fermi level and  $E_1, E_2$  eV below the Fermi level.  $P_1$  and  $P_2$  are respectively the probability of  $E_1$  being occupied by an electron and  $E_2$  being empty. Then :
- (A)  $P_1 > P_2$
  - (B)  $P_1 = P_2$
  - (C)  $P_1 < P_2$
  - (D)  $P_1$  and  $P_2$  depend on the number of free electrons
49. If  $E_F$  is independent of the temperature then a Fermi level can be defined as the level which has :
- (A) 100%
  - (B) 25%
  - (C) 50%
  - (D) 75%
50. The dependence to charge carrier on temperature for an intrinsic semiconductor is:
- (A) Exponential
  - ~~(B) Parabolic~~
  - (C) Logarithmic
  - (D) Independent
- \*\*\*\*\*