

SEMESTER END EXAMINATION, APRIL-MAY, 2025

Course Name: - B.Tech

Semester: - II

Paper Name: - Fundamental of Electrical and Electronics Engineering

Paper Code: - NES 202

Time - 3 Hrs + 20 minutes per hour extra time for V.I. & examinees with writer.

Max Marks-70

Additional 30 Minutes for Mid-Test.

Instructions:

- The question paper consists of three sections namely A, B, C. All sections are compulsory.
- Section A- Each question carries 3 mark. All questions are compulsory.
- Section B- Answer any 5 out of 7 given questions. Each question carries 7 marks.
- Section C- Answer any 2 out of 3 given questions. Each question carries 10 marks.
- Section D- Each question carries 02 mark. All questions are compulsory.

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Section - A (खण्ड-अ)

Objective Questions (वस्तुनिष्ठ प्रश्न)

1. Answer all the following questions.

5x3=15

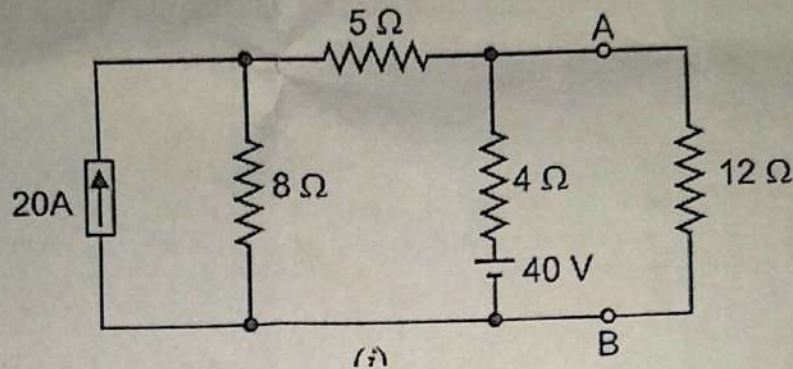
- i) If a 1Ω , 2Ω , $32/3\Omega$ resistor is connected in star, find the equivalent delta connection
- a. 34Ω , 18.7Ω , 3.2Ω
b. 33Ω , 18.7Ω , 3.2Ω
c. 34Ω , 19.7Ω , 3.2Ω
d. 33Ω , 19.7Ω , 3.2Ω
- ii) Flux density in the air gap between N and S poles is 2.5 Wb/m^2 . The poles are circular with a diameter of 5.6 cm, the total flux crossing the air gap is
- a. 4.95 mWb
b. 5.13 mWb
c. 5.87 mWb
d. 6.16 mWb
- iii) An a.c. voltage of peak value 20 V is connected in series with a silicon diode and load resistance of 500Ω . If the forward resistance of diode is 10Ω , Peak output voltage is
- a. 16.2 V
b. 17.6 V
c. 18.9 V
d. 20.1 V
- iv) In voltage divider bias, $V_{CC} = 25 \text{ V}$; $R_1 = 10 \text{ k}\Omega$; $R_2 = 2.2 \text{ k}\Omega$; $R_C = 3.6 \text{ k}\Omega$ and $R_E = 1 \text{ k}\Omega$, the emitter voltage (V_E) is
- a. 4.9 V
b. 3.8 V
c. 2.9 V
d. 2.2 V
- v) The following expression $Y = \overline{AB} + \bar{A} + AB$, gives
- a. \bar{A}
b. B
c. 1
d. 0

Section - B (खण्ड-ब)
Short Answer Questions (लघुउत्तरीय प्रश्न)

2. Answer any five of the following questions in maximum 150 words.
 निम्नलिखित में से किन्हीं पाँच प्रश्नों के उत्तर अधिकतम 150 शब्दों में दें।

5x7=35

- i. Draw Norton's equivalent circuit at terminals AB and determine the current flowing through 12Ω resistor for the network shown in Fig.



- ii. Explain the resonance in series A.C. circuit in terms of graphical explanation, resonance curve, Q-factor and bandwidth.
- iii. Explain the autotransformer with proper figure in detail. Also draw the equivalent circuit of transformer in conditions when primary circuit referred to secondary.
- iv. What is pn junction and depletion layer? Discuss the behaviour of a pn junction under forward and reverse biasing. Also, draw and explain the V-I characteristics of a pn junction.
- v. Explain the principle and working of the Hall Effect with a proper figure. Discuss the role of the Hall Effect in determining the mobility of charge carriers.
- vi. With a neat sketch, explain the working of bridge full-wave rectifier along with the nature of rectifier output. Also, derive an expression for the ripple factor of full-wave rectifier.
- vii. Explain the construction and working of MOSFET with proper diagram. Also draw the MOSFET transfer characteristic along with n-channel MOSFET symbols.
- viii. Minimize the following Boolean expression using K-map and realize it using the basic logic gates: $Y = \prod M(0,2,3,7)$ and $Y = \sum m(0,2,4,6,9,11,13,15,17,21,25,27,29,31)$

Section - C (खण्ड-स)
Descriptive Questions (विवरणात्मक प्रश्न)

3. Answer any two of the following question in maximum 300 words.
 निम्नलिखित में से किन्हीं दो प्रश्नों के उत्तर अधिकतम 300 शब्दों में दें।

2x10=20

- i. Derive an expression for barrier potential (V_B) across the pn junction in terms of doping concentration (N_a and N_d) and width of space charge region (X).
- ii. Explain the construction and working of clipping and clamping circuits with input and output wave form, suppose input signal is sine wave.

- iii) Describe in detail the construction and working of npn transistor. Also, draw the input and output characteristics of common base (CB) connection.

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Mid-Test

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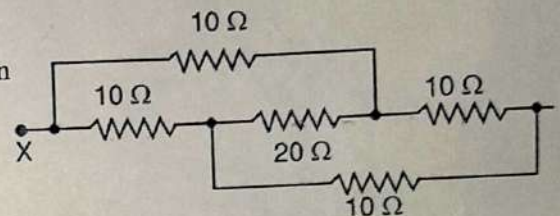
Objective Questions.

1. Power factor ($\cos \phi$) of pure capacitor, inductor and pure resistor are such as

- a. 1, 0, 1
- b. 0, 1, 1
- ☒ c. 0, 0, 1
- d. 1, 0, 0

2. The equivalent resistance between points X and Y in

- ☒ a. 10 Ω
- b. 22 Ω
- c. 20 Ω
- d. 50 Ω



3. The current in a circuit is given by $(4.5 + j12)$ A when the applied voltage is $(100 + j150)$ V. Determine the impedance value

- a. $13.06 \angle -10.13^\circ$ W
- ☒ b. $14.06 \angle -13.13^\circ$ W
- c. $13.06 \angle -13.13^\circ$ W
- d. $14.06 \angle -10.13^\circ$ W

$$\frac{1}{16} + \frac{1}{30} - \frac{2}{16} = \frac{7}{240}$$

$$\frac{7}{240} \times 240 = 7$$

4. A toroidal coil has a magnetic path length of 33 cm and a magnetic field strength of 650 A/m. The coil current is 250 mA, the number of coil turns

- a. 789 turns
- b. 818 turns
- ☒ c. 832 turns
- d. 858 turns

5. The PN junction acts as a

- a. controlled switch
- b. bidirectional switch
- ☒ c. unidirectional switch
- d. not worked as a switch

6. In intrinsic semiconductor, the function $F(E) = 1$ if

- a. $E > E_F$ and $T = 0$ K
- ☒ b. $E < E_F$ and $T \neq 0$ K
- c. $E < E_F$ and $T = 0$ K
- d. $E > E_F$ and $T \neq 0$ K

7. In a transistor, $I_B = 68 \mu A$, $I_E = 30 \text{ mA}$ and $\beta = 440$, values of α and I_C is

- ☒ a. 0.9977 & 29.93 mA
- b. 0.9165 & 29.93 mA
- c. 0.9165 & 28.53 mA
- d. 0.9977 & 28.53 mA

x 2

8. Determine the value of base x if $(211)_x = (152)_8$

- ☒ a. 4
- b. 5
- c. 6
- d. 7

9. What is the size of Nibble

- a. 1
- b. 2
- ☒ c. 4
- d. 8

x 2

10. Simplify the following Boolean expression $Y = AB + ABC + A\bar{B}$

- a. AB
- ☒ b. A
- c. B
- d. 0

x ✓

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समय- 3 घण्टे + 20 मिनट प्रति घंटे अतिरिक्त-दृष्टिबाधित एवं सह लेखक परीक्षार्थियों के लिए।
30 मिनट अतिरिक्त मिड-टेस्ट के लिए।

अधिकतम अंक-70

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- Section D- Each question carries 02 mark. All questions are compulsory.
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Section - A (खण्ड-अ)

Objective Questions (वस्तुनिष्ठ प्रश्न)

1. Answer all the following questions.

5x3 =15

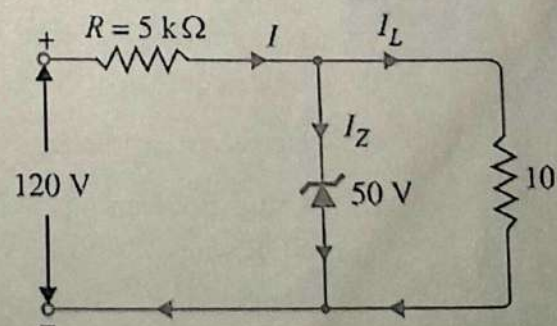
निम्नलिखित सभी प्रश्न अनिवार्य हैं।

- i) A copper wire is stretched so that its length is increased by 0.1%. What is the percentage change in its resistance?
- a. 0.1 %
 - ✓ b. 0.2 %
 - c. 0.3 %
 - d. 0.4 %

- ii) A specimen of iron is uniformly magnetised by a magnetising field of 500 A/m. If the magnetic induction in the specimen is 0.2 Wb/m^2 , susceptibility is
- a. 317.5
 - ✓ b. 318.4
 - c. 319.6
 - d. 320.1

iii) For the given circuit, the current through zener diode.

- a. 6 mA
- ✓ b. 9 mA
- c. 12 mA
- d. 0 mA



iv) In voltage divider bias, operating point is 3 V, 2 mA. If $V_{CC} = 9 \text{ V}$, $R_C = 2.2 \text{ k}\Omega$, the value of R_E is

- ✓ a. 1500 Ω
- b. 1200 Ω
- c. 800 Ω
- d. 600 Ω

~~OK~~

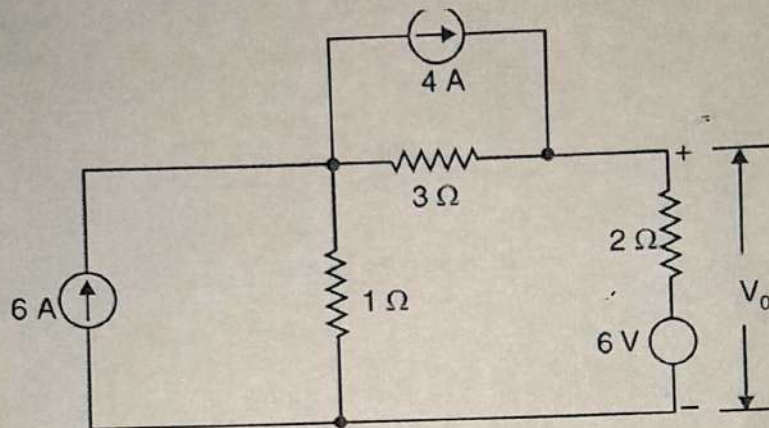
- v) Convert decimal number 3509.25 to its hexadecimal equivalent
- $(CD4.2)_{16}$
 - $(CE5.4)_{16}$
 - $(AB4.2)_{16}$
 - $(DB5.4)_{16}$ ✓

Section - B (खण्ड-ब)
Short Answer Questions (लघुउत्तरीय प्रश्न)

5x7=35

2. Answer any five of the following questions.
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- i. Using superposition theorem, find the value of output voltage V_0 in the circuit shown in figure



- A voltage of 200 V is applied to a series circuit consisting of a resistor, an inductor and a capacitor. The respective voltages across these components are 170 V, 150 V and 100 V and the circuit current is 4A. Find the power factor of the inductor and of the circuit.
- What is MMF? Explain the Single Loop DC Generator along with all proper diagrams. Also, write down the EMF Equation of a DC Generator.
- With a neat sketch, explain the energy band formation in semiconductor. Also, write short note on (i) II-VI compound semiconductor, (ii) diode as a switch, (iii) diode testing and (iv) diode equivalent circuit.
- Derive an expression for the efficiency and ripple factor of a half-wave rectifier.
- Using Boolean algebra, draw the Ex-OR gate using minimum number of NAND gates and NOR gates.

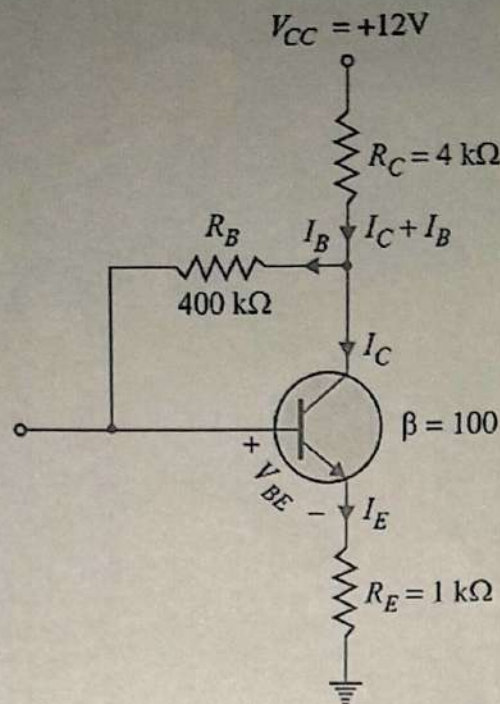
Section - C (खण्ड-स)
Descriptive Questions (विवरणात्मक प्रश्न)

2x10=20

3. Answer any two of the following question.
 निम्नलिखित में से किन्हीं दो प्रश्नों के उत्तर दें।

- i) Explain in detail the (i) Fermi energy, (ii) charge densities, (iii) mobility, drift-velocity, & conductivity and (iv) drift & diffusion current in semiconductor.

- ii) Describe the various methods used for transistor biasing. State their advantages and disadvantages. Find the Q-point values (I_C and V_{CE}) for the collector feedback bias circuit shown in figure. Assume the transistor to be of silicon.



- iii) Explain the construction and working of a n-channel JFET. In an n-channel JFET biased by potential divider method, it is desired to set the operating point at $I_D = 2.5$ mA and $V_{DS} = 8$ V. If $V_{DD} = 30$ V, $R_1 = 1$ M Ω and $R_2 = 500$ k Ω , find the value of R_S . The parameters of JFET are $I_{DSS} = 10$ mA and $V_{GS}(\text{off}) = -5$ V.

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सभी प्रश्न अनिवार्य हैं।

Objective Questions.

बहुविकल्पीय प्रश्न।

- i) If all delta resistors are 6 Ω , what will be the equivalent star resistors?
- 2 Ω
 - 3 Ω
 - 4 Ω
 - 6 Ω
- ii) A load with active power 4 kW and apparent power 5 kVA has a power factor of:
- 0.5
 - 0.6
 - 0.8
 - 1

- iii) A 230 V, 50 Hz supply is applied to a series R-L circuit with $R = 10 \Omega$ and $L = 0.1 \text{ H}$. What is the current magnitude?
- 20.9 A
 - 15.5 A
 - 10.0 A
 - 13.5 A
- iv) What is the relationship between MMF (Magnetomotive Force) and magnetic flux?
- MMF = Flux \times Reluctance
 - MMF = Flux / Reluctance
 - MMF = Flux \times Permeability
 - MMF = Flux \times Resistance
- v) For a sample with $n = 10^{21} \text{ electrons/m}^3$, $B = 0.1 \text{ T}$, $I = 1 \text{ A}$, thickness = 1 mm, Hall voltage is:
- 16 μV
 - 160 μV
 - 1.6 mV
 - 16 mV
- vi) Which of the following is a donor impurity in silicon?
- Boron
 - Gallium
 - Arsenic
 - Indium
- vii) In a transistor, $I_B = 68 \mu\text{A}$, $I_E = 30 \text{ mA}$ and $\beta = 440$, values of I_{CEO} is
- 12 μA
 - 24 μA
 - 31 μA
 - 53 μA
- viii) What is the binary number corresponding to 5-bit Gray code 10110
- 11101
 - 11001
 - 10011
 - 11110
- ix) For an N-channel MOSFET in the saturation region, which condition is true?
- $V_{DS} = V_{GS}$
 - $V_{DS} < V_{GS} - V_{th}$
 - $V_{DS} = V_{GS} - V_{th}$
 - $V_{DS} > V_{GS} - V_{th}$
- x) Which of the following is the correct simplification of the Boolean expression $(A + B)(A + C)(B + C)$?
- $A + B + C$
 - $AB + AC + BC$
 - $A.B.C$
 - $A + C$
- *****