

- Note: 1) All questions are compulsory.
 2) Use of non- programmable calculator is allowed.
 3) Draw figures wherever necessary.
 4) Symbols have their usual meanings unless mentioned.

Q.1 (A) Select the correct option

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- i) The reactance of inductor of inductance 1H at 50Hz is _____.
 (a) 314Ω (b) $3.14k\Omega$
 (c) 31.4Ω (d) $314k\Omega$
- ii) _____ Bridge is used for comparing inductance of unknown inductors.
 (a) Wein (b) De Sauty's
 (c) Maxwell's (d) Hay's
- iii) In half adder circuit, sum and carry are represented by outputs of _____ and _____ gates respectively.
 (a) AND, OR (b) Ex-OR, AND
 (c) Ex-OR, OR (d) NAND, NOR
- iv) The source delivers maximum power to the load when source resistance is _____.
 (a) greater than load (b) less than load
 (c) equal to load (d) equal to zero
- v) The unit of the electric potential is _____.
 (a) newton-meters per coulomb (b) joules per coulomb
 (c) volt (d) all of the above
- vi) The magnetic induction at the centre of circular coil having 'n' turns and radius 'r' is _____.
 (a) $\mu_0 In/2r$ (b) $2\mu_0 In/r$
 (c) $\mu_0 In$ (d) $\mu_0 In/r$

(B) Answer in one sentence :

03

- i) What is power factor in AC circuit?
- ii) State the application of Zener diode.
- iii) State Lorentz force law.

(C) Fill in the blanks

05

- i) In LCR parallel AC circuit, at resonance the impedance of the circuit is_____.
- ii) In Norton's theorem entire linear network connected across two terminals can be replaced by equivalent _____ in parallel with a single equivalent_____.
- iii) The internal resistance of ideal current source is _____.
- iv) _____ and _____ gates are called as universal building blocks.
- v) The surface over which the potential is constant is called _____.

- Q.2 (A) Attempt any one 08
- Derive an expression for the impedance of the series CR circuit applied by alternating emf and hence draw its phasor diagram.
 - An alternating emf is applied to series LCR circuit. Derive an expression for its resonant frequency.
- (B) Attempt any one 08
- What is an AC bridge? Obtain the conditions required to balance the bridge.
 - Draw a neat circuit diagram and derive balance condition for Maxwell's LC bridge.
- (C) Attempt any one 04
- A series LR circuit has an inductance of 0.2H and a resistance of 5Ω connected across 200V AC at 50Hz. Calculate the impedance of the circuit and phase angle between emf and current
 - In a Wien bridge, if $R_1=R_2=5K\Omega$ and $C_1=C_2=0.022\mu F$. Find the frequency of input voltage.
- Q.3 (A) Attempt any one 08
- State Thevenin's theorem and explain it in detail.
 - Draw a neat labeled diagram of Bridge rectifier. Explain its working and draw necessary waveforms.
- (B) Attempt any one 08
- What is a clipper? What are its types? Explain working of any one type of clipper with the help of diagram.
 - What are derived gates? Draw logic circuit, symbol and write truth-table for any two of them.
- (C) Attempt any one 04
- Simplify the expression $Y = (A+B).(A+C)$ and design logic circuit for the output using basic gates.
 - In a bridge rectifier, maximum secondary voltage is 136 V, 50Hz. Find dc load voltage, peak inverse voltage and output frequency.
- Q.4 (A) Attempt any one 08
- Obtain an expression for potential energy of a discrete point charge distribution.
 - Derive an expression for the magnetic field produced by a current carrying circular loop at a point on its axis.
- (B) Attempt any one 08
- Obtain an expression for the potential of a localized charge distribution.

- ii) What is Helmholtz coil? Obtain the condition for maximum and uniform magnetic induction at mid point on the axis of the coil.

(C) Attempt any one

04

- i) A beam of electron enters a uniform magnetic field of 0.1 Wb/m^2 with velocity of $2 \times 10^4 \text{ m/s}$ making an angle of 30° with the field direction. Calculate the radius of helical path traced by it.
[Given: $m_e = 9.1 \times 10^{-31} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ C}$]
- ii) Find the magnetic induction in air at 0.01 m from a wire that carries a current of 1 A . [Given: $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$]

Q.5 Attempt any four

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- i) Show that in a pure resistive AC circuit, the emf and current are in phase.
- ii) Draw a neat circuit diagram of De Sauty's AC bridge and write down the expression for balance condition.
- iii) Define efficiency of a rectifier. Find its value for half wave rectifier.
- iv) A 400 mW Zener diode with breakdown voltage 5 V has negligible resistance. Find the maximum current it can carry. What is the current limiting resistance for this Zener to carry maximum current if supply voltage is 15 V .
- v) Two long straight wires carrying currents of 5 A and 15 A are separated by a distance of 100 cm . At what point on the line joining the wires is the magnetic field zero?
- vi) Show that the work done in moving charge q from infinity to a point is $W=qV(r)$.
