

**3 HRS****100 MARKS**

- 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 12
- In case of pure capacitor connected to ac source, phase angle between capacitor voltage and current is \_\_\_\_\_ degrees.  
 (a) 0 (b) 180  
 (c) 90 (d) 45
  - \_\_\_\_\_ bridge is used to determine frequency of ac source.  
 (a) De Sauty (b) Wien  
 (c) Maxwell (d) Hay
  - 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
  - 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
  - When charge  $Q$  is accelerated through a potential difference  $V$ , it gains energy \_\_\_\_\_.  
 (a)  $Q.V$  (b)  $Q^2.V$   
 (c)  $Q/V$  (d)  $Q^2/V$
  - The resultant field between the two coils of Helmholtz coil arrangement is inversely proportional to the \_\_\_\_\_.  
 (a) current (b) permeability of free space  
 (c) number of turns (d) radius
- (B) Answer in one sentence : 03
- Why LCR parallel circuit is called as a rejecter circuit?
  - Define efficiency of a rectifier.
  - What is the magnitude of electric field on the equipotential surface?
- (C) Fill in the blanks 05
- The quantity \_\_\_\_\_ is called as inductive reactance.
  - The internal resistance of ideal current source is \_\_\_\_\_.
  - The sum of half adder is represented by \_\_\_\_\_ gate.
  - The ripple factor of bridge rectifier is \_\_\_\_\_.
  - SI unit of electrostatic potential is \_\_\_\_\_.
- Q.2 (A) Attempt any one 08
- A sinusoidal voltage is applied across series LR circuit. Show that current lags behind the applied voltage. Draw series relevant phasor diagram.
  - Derive expression for the instantaneous power dissipated by an ac circuit. Hence define true power and derive expression for it.

- (B) Attempt any one 08
- Draw a neat labeled diagram of Maxwell LC bridge and find balancing conditions of the bridge.
  - With the help of circuit diagram determine balancing condition for De Sauty's bridge. State one application of the bridge.
- (C) Attempt any one 04
- In series LCR circuit, resonance occurs at frequency 10 KHz. If  $R = 10\Omega$  and inductive reactance is  $200\Omega$  at resonance. Find the bandwidth of the circuit.
  - In Wien bridge both the resistors and capacitors are of same value. If  $R = 470\Omega$  and  $C = 0.1\mu F$ , then find the frequency of the ac source used.
- Q.3 (A) Attempt any one 08
- State Thevenin's theorem and explain it in detail.
  - What are the binary adders? Describe full adder in detail.
- (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.
  - State and prove De Morgan's laws.
- (C) Attempt any one 04
- Simplify the expression  $Y = (A+B).(A+C)$  and design logic circuit for the output using basic gates.
  - Find the Zener current when Zener diode of voltage 7.2 V is connected across a power supply of 12 V and series resistance of 1 K $\Omega$ . The load resistance of 5 K $\Omega$  is connected across the Zener.
- Q.4 (A) Attempt any one 08
- Obtain an expression for the potential energy stored in a system of N discrete point charges.
  - Explain how electric field can be expressed in terms of electric potential. comment on the potential.
- (B) Attempt any one 08
- Derive an expression for the magnetic field at a point at a distance x from a straight current carrying wire of finite length. Modify the result for infinitely long wire.
  - What is a solenoid? Derive an expression for the magnetic field at a point well inside on the axis of a current carrying air core solenoid.
- (C) Attempt any one 04
- Find the work done in moving a charge of +1e from (2,0)m to (0,2)m along a straight line path joining these two points in electric field  
 $E = (2x\hat{i} - 4y\hat{j})$
  - A circular coil having 30 turns carries a current of 0.5A. If the diameter of the coil is 0.1 m, calculate the magnetic field at the centre of the coil. Given :  
 $\mu_0 = 4\pi \times 10^{-7} \text{ N/A}^2$



Q.5 Attempt any four

- i) An ac source specified as  $V = 200 \sin 100t$  is connected across series CR circuit with  $C = 1\mu\text{F}$  and  $R = 10\text{K}\Omega$ . Calculate maximum potential difference across the capacitor.
- ii) In a Maxwell LC bridge, when bridge is in the balanced, the following component values were observed.  $R_2 = 900\Omega$ ,  $R_3 = 1000\Omega$ ,  $R_4 = 2700\Omega$  and  $C = 0.47\mu\text{F}$ . Determine the value of inductance and the resistance of the coil.
- iii) State maximum power transfer theorem. Calculate the maximum power delivered to the load of  $1\text{K}\Omega$  by a source with open circuit voltage  $5\text{V}$ .
- iv) Explain why NAND gate is called as universal building block.
- v) State and explain Biot-Savart law.
- vi) A uniformly charged spherical shell of radius  $R$  carries a total charge  $q$ . Find the electrostatic potential at a point P, (i) outside and (ii) inside the shell.

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