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3 (Sem-1/CBCS) ELE HC 1

2021

(Held in 2022)

ELECTRONICS

(Honours)

Paper : ELE-HC-1016

(Basic Circuit Theory and Network Analysis)

Full Marks : 60

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

1. Answer the following multiple-choice questions : $1 \times 7 = 7$

(i) An inductor works as a/an _____ circuit for DC supply.

(a) open

(b) short

(c) polar

(d) nonpolar

(ii) Nodal analysis is mainly based on

(a) KVL

(b) KCL

Contd.

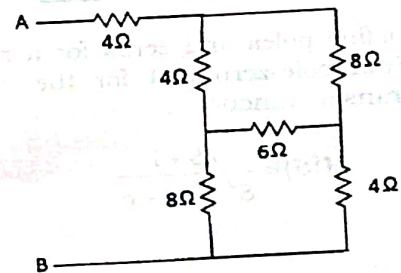
- (c) Wheatstone bridge principle
 (d) Faraday's electric laws
- (iii) With double the number of turns by the same length and area, the inductance of an inductor will be
 (a) the same
 (b) doubled
 (c) tripled
 (d) quadrupled
- (iv) To tune a parallel resonant circuit to a higher frequency, the capacitance should be
 (a) increased
 (b) decreased
 (c) replaced with inductance
 (d) None of the above
- (v) Superposition theorem can be applied only to circuits having
 (a) resistive elements
 (b) passive elements
 (c) nonlinear elements
 (d) linear bilateral elements
- (vi) Bridge rectifier is an alternative for
 (a) full-wave rectifier
 (b) half-wave rectifier
 (c) peak rectifier
 (d) None of the above

- (vii) An ideal voltage source should have
 (a) large value of e.m.f.
 (b) small value of e.m.f.
 (c) zero source resistance
 (d) infinite source resistance

2. Answer the following questions : $2 \times 4 = 8$
 (i) How does the capacitance of a capacitor change with the change in dielectric constant ?
 (ii) Draw the equivalent circuit diagram of an ideal current and voltage source.
 (iii) Find the Laplace transform of e^{-at} .
 (iv) Write down Kirchhoff's circuit laws.

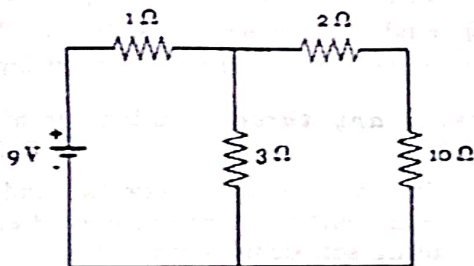
3. Answer **any three** questions from the following : $5 \times 3 = 15$

- (i) For the following network, find the equivalent resistance between A and B using star-delta conversion :



- (ii) For a sinusoidal ac waveform, define the following :
- Time period
 - Amplitude
 - RMS value
 - Instantaneous value

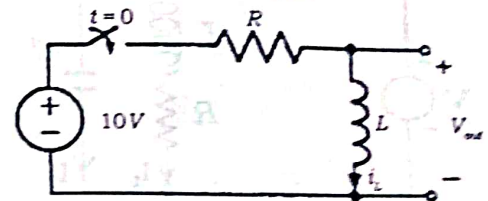
- (iii) State Norton's theorem. For the following circuit, determine the current through $10\ \Omega$ resistance using Norton's theorem :



- (iv) Define poles and zeros for a network. Find pole-zero plot for the following transfer function :

$$H(S) = \frac{2S+1}{S^2+5S+6}$$

- (v) In the following circuit the switch closes at time $t = 0$, before which it had been open for a long time. Use Kirchoff's voltage law to derive a differential equation for the following circuit, and solve it to find $V_{out}(t)$:

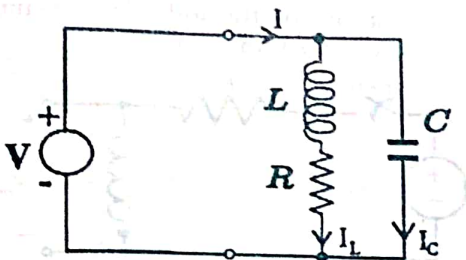


- (vi) State and explain Faraday's law and Lenz's law of electromagnetic induction.

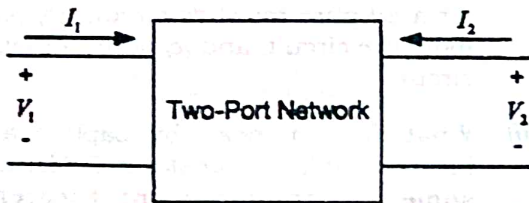
4. Answer **any three** questions from the following : 10×3=30

- Derive the expressions of active power for a (a) pure resistive circuit, (b) pure inductive circuit, and (c) pure capacitive circuit. 10
- What do you mean by Laplace and inverse Laplace transform? Mention some of the important theorems regarding Laplace transform. Find Laplace transform of t^n . 4+2+4=10

- (iii) For the parallel RLC circuit given below, find out an expression for resonance frequency and impedance at resonance : 10



- (iv) State and proof superposition theorem. Write down the significance of superposition theorem. 8+2=10
- (v) For the two-port network given below, identify dependent and independent variables :



Find out the expressions for short circuit admittance parameters Y_{11} , Y_{21} , Y_{12} and Y_{22} . 2+8=10

- (vi) Write short notes on the following : 5+5=10
- (a) Reciprocity theorem
- (b) Self and mutual inductance