MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : ES-EE-101

BASIC ELECTRICAL ENGINEERING

Time Allotted: 3 Hours | *Full Marks*: 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

The questions are of equal value.

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternative for *any ten* of the following questions: 1×10=10

(i) If there are two bulbs connected in series and one blows out the following may happen:

(a) The other bulb continues to glow with the same brightness

(b) The other bulb stops glowing

(c) The other bulb glows with increased brightness

(d) The other bulb also burns out

(ii) If the applied voltage across a lamp is reduced by 50%, then the power consumption will reduce to

(a) 50% (b) 75%

(c) 25% (d) 40%

(iii) The form factor of a current waveform is 1. The shape of the waveform is

(a) sinusoidal (b) triangular

(c) square (d) saw tooth

(iv) The DC motor needs a starter during starting to control

(a) speed
(b) voltage
(c) current
(d) flux

(v) DC voltage of 100V is applied to a circuit consisting of a resistance of 10Ω and inductance of 5 Henry connected in series. The time constant of the circuit is

(a) 2S
(b) 1S
(c) 0.5S
(d) 0.25S

(vi) The superposition theorem satisfies the principle of

(a) Reciprocity
(b) Duality
(c) Linearity
(d) Non-linearity

(vii) The ratio of output voltage to input voltage of a boost converter operating at a duty cycle 'D' is given by

(a) D
(b) $1 - D$
(c) $\frac{1}{1-D}$
(d) $\frac{1}{D}$

(viii) Two alternating currents are represented by $l_1 = \sin(wt - 30°)$ and $l_2 = \sin(wt + 30°)$.

(a) l_1 leads l_2 by 60°
(b) l_1 lags l_2 by 60°
(c) l_2 leads l_1 by 30°
(d) l_2 lags l_2 by 30°

(ix) The positive plates of nickel iron cell is made up of

(a) Nickel hydroxide
(b) Lead peroxide
(c) Ferrous hydroxide
(d) Potassium hydroxide

(x) The maximum efficiency of the transformer occurs at when

(a) Iron loss = Copper loss
(b) Eddy current loss = Copper loss
(c) Hysteresis loss = Copper loss
(d) Iron loss > Copper loss

(xi) The frequency of emf induced in the rotor of a 3 phase, 50 Hz induction motor at standstill is

(a) 0 Hz
(b) 50 Hz
(c) 25 Hz
(d) 100 Hz

(xii) The field of a synchronous generator is excited by

(a) AC supply
(b) DC supply
(c) Either by AC or DC supply
(d) Composite AC and DC supply

Group – B

(Short Answer Type Questions)

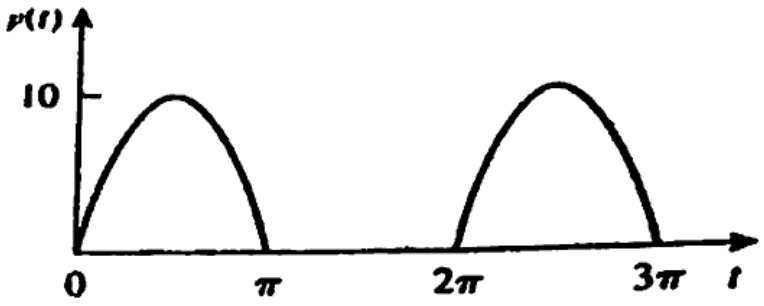
Answer *any three* of the following. 5×3=15

2. Explain the principle of working of a single phase induction motor.

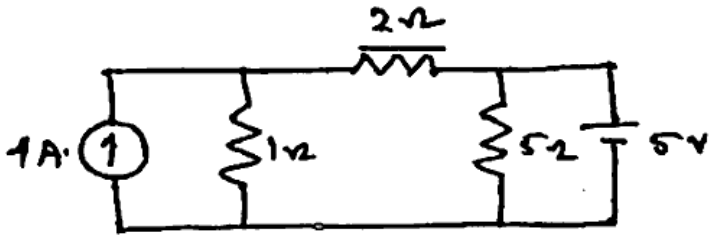
3. A coil having a resistance of 5 Ω and inductance of 0.1 H is connected in series with a 50 μF capacitor. A sinusoidal voltage of 200V is applied to the circuit. At what frequency the current in the circuit will be maximum? Calculate this current & voltage across the capacitor at this frequency.

4. A series circuit consisting of a non-inductive resistor of RΩ & a pure inductance of L Henry connected across a DC voltage some of V volts through a switch *S*. Derive the equation of the current in the circuit at any instant '*t*' after closing the switch.

5. Find the average and rms voltage of the voltage waveform shown. What is the power dissipation across a 9 Ω resistor. Supplied with voltage.



6. Using superposition theorem find the current through the resistor 5 Ω in the Circuit shown.



Group – C

(Long Answer Type Questions)

Answer *any three* of the following. 15×3=45

7. (a) A 15 KVA, 1100/110V, 50 Hz single phase transformer has the following test results:

Open circuit test LV side: 110 V, 0.8 A, 90 W

Short circuit test HV side: 70 V, 12 A, 100 W

Determine the following

(i) core loss of the transformer.

(ii) equivalent resistance & leakage reactance referred to the HV side.

(iii) equivalent resistance and the leakage reactance referred to the LV side.

(iv) regulation of transformer at full load and half load of 0.8 pf lagging.

(v) efficiency of the transformer at full load and half load at 0.8 pf lagging.

(b) Draw the connection and phasor diagram at the following two types of three phase transformers.

Yy6 & Yd1 10+5=15

8. (a) Explain the meaning of phase and phase difference of sinusoidal quantities.

(b) A coil of resistance of 30Ω and inductance 320 mH is connected in parallel to a circuit consisting of a 75 Ω resistor in series with 150 μF capacitor. The circuit is connected to a 200 V, 50 Hz supply. Determine the supply current and circuit power factor.

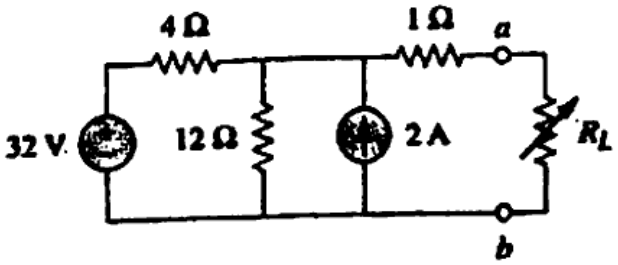
(c) At t = 0, the instantaneous value of 50 Hz sinusoidal current is 5A and increase in magnitude further. Its rms value is 10A.

(i) Write the expression of its instantaneous value.

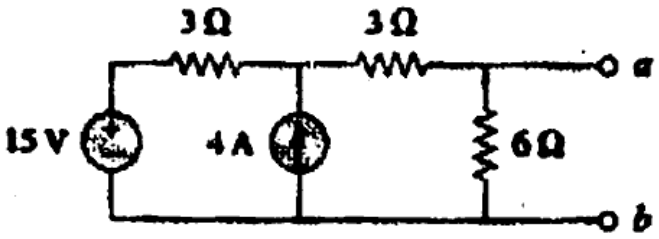
(ii) Find the current at F = 0.01 s and t = 0.015 s

(iii) Sketch the waveforms indicating these values. 2+8+5=15

9. (a) Find the Thevenin equivalent of the circuit across a – b, shown in the figure below:



(b) Determine the Norton equivalent of the circuit shown below:



(c) A balanced mesh connected load of $(6 + j8)\Omega$ is connected across a 3 phase, 50 Hz, 230 V supply system. Calculate: 5+5+5=15

(i) line current

(ii) power factor

(iii) active power

10. (a) A 3 phase 50 Hz induction motor has a full load speed of 1440 rpm. Calculate:

(i) Slip

(ii) No. of poles

(iii) frequency of induced emf of rotor

(iv) speed of rotor field with respect to rotor structure

(v) speed of rotor field with respect to stator field

(b) Explain with relivant diagram the method of speed control of a separately excited DC motor. 8+7=15

11. Write notes on *any three* of the following: 3×5=15

(a) Three phase voltage source inverter

(b) Method of power factor improvement

(c) Buck converter

(d) Auto transformer
