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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Scheme for Valuation/Answer Key

Scheme of evaluation (marks in brackets) and answers of problems/key

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: BE101-03

Course Name: INTRODUCTION TO ELECTRICAL ENGINEERING

Max. Marks: 100

Duration: 3 Hours

PART A

1. $E = \frac{1}{2}LI^2$ Joules Derivation-4 marks

2. Self-inductance $L = 0.266$ Henry-----2 marks

Self-induced emf $e_s = 319.2V$ -----2 marks

3. KCL- 2 marks, KVL- 2marks

4. Definition of self and mutual inductance (1 + 1) Derivation (2 marks)

5. $20 < -30$ OR $14.14 < -30$ Polar Form- 2 Marks

$17.32 - 10j$ OR $12.25 - 7.07j$ Rectangular Form-2 marks

6. Proof-4 marks

7. Power triangle-1 mark, explanation of each term- 1 mark each

8. Let $v = V_m \sin \omega t$ and $i = I_m \sin(\omega t - \phi)$ then Power $p = vi = V_m I_m \sin \omega t \sin(\omega t - \phi)$
 $= \frac{1}{2} V_m I_m [\cos \phi - \cos(2\omega t - \phi)]$

The average power over a complete cycle is calculated as

$$P_{av} = \frac{1}{2\pi} \int_0^{2\pi} \frac{1}{2} V_m I_m [\cos \phi - \cos(2\omega t - \phi)] d\omega t$$

$$P_{av} = \frac{V_m I_m}{2} \cos \phi = VI \cos \phi$$

9. $I_L = 10.32 \angle -26.54^\circ$ A , (1) $\cos \phi = 0.8943$ (1), $P = 6394.79$ W (2)

10. Four points – 1 mark each



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PART B

- 11. a. Faradays two laws----2 + 2
- b. $\phi = 0.028wb$ -----2 marks
- $L = 3.73H$ -----2 marks
- $e = 1119V$ ----2 marks

12. Mesh Equations

$6I_1 + 2I_2 + I_3 = 7$ ----- (2 marks)

$I_1 - I_3 = 7$ ----- (2 marks)

$-I_1 + 6I_2 - 3I_3 = 0$ ----- (2 marks)

Mesh Currents

$I_1 = 2.52 \text{ A}$ (1 mark)

$I_2 = -1.82 \text{ A}$ (1 mark)

$I_3 = -4.48 \text{ A}$ (1 mark)

Current through the 3Ω resistor = $I_3 - I_2$ (OR $I_2 - I_3$)

= -2.66 A (OR 2.66 A) 1mark

13. $S_f = 5786$ ----1 mark

$S_g = 42435$ ----1 mark

$\phi = 0.051wb$ ----2 marks

$L = 1.275H$ -----2 marks

$\Phi = 8 \times 10^{-4} \text{ Wb}; A = 10 \text{ cm}^2 \quad B = \Phi/A$

Airgap

$H = B/\mu_0 = 6.366 \times 10^5 \text{ AT/m}$

AT required = $H \times L = 6.366 \times 10^5 \times 4 \times 10^{-4} = 255 \text{ AT}$ ----1 mark

Caststeel path

$H = B/C, = 796 \text{ AT/m}$

AT required = $H \times L = 796 \times \pi D/2 = 263 \text{ AT}$ ----1 mark

Cast iron path

$H = B/\mu_0 \mu_r, = 3835 \text{ AT/m}$

AT required = $H \times L = 3835 \times \pi D/2 = 1265 \text{ AT}$ ----1 mark



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Total AT = 255+263+1265=1783 AT ----1 mark

14. a. 5 similarities (4 marks)
differences (2 marks)

b. Parallel connection – mmfs are same ($AT_1 = AT_2 = AT$)

Total flux is sum of fluxes $\phi = \phi_1 + \phi_2$

Hence, $\frac{AT}{S} = \frac{AT}{S_1} + \frac{AT}{S_2}$

$\frac{1}{S} = \frac{1}{S_1} + \frac{1}{S_2}$; 4 x 1 = 4 marks

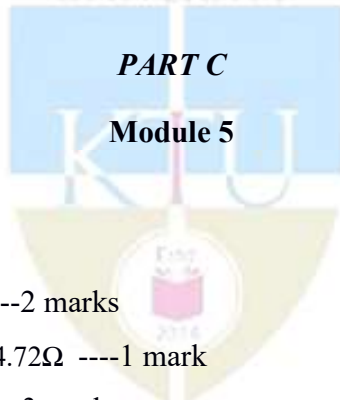
15. RMS value-5 marks

Average Value-5 marks

16. $R_{eff} = 11.2\Omega, Z = 25X_L = 22.35, L = 0.07H$

$V_{coil} = 179.05, power_{coil} = 76.8W, P_R = 640W, P_{total} = 716.8W$

Voltage phasor diagram (2 marks each for each part)



17. $V = 40 + j30 = 50 \angle 36.9^\circ$

$I = 4 + j1 = 4.123 \angle 14^\circ$

$Z = V/I = 12.13 \angle 22.9^\circ = 11.17 + j4.72$ ----2 marks

$R = 11.17 \Omega$ ----1 mark and $X_L = 4.72 \Omega$ ----1 mark

Power consumed $P = I^2 R = 189.88W$ ----3 marks

Power factor = $\cos 22.9 = 0.921$ lagging----3 marks

18. a. Resonant frequency $f_r = 159.2 \text{ Hz}$ ----1 mark

$Z = 10 \Omega$ (resistive) ----1 mark

At 149.2 Hz, $X_L = j93.716 \Omega$ ----1 mark, $X_C = -j106.7 \Omega$ ----1 mark,

$Z = 10 - j13 = 16.38 \Omega$ (capacitive) Ω ----1 mark,

At 169.2 Hz, $X_L = j106.28 \Omega$ ----1 mark, $X_C = -j94.09 \Omega$ ----1 mark,

$Z = 10 - j12.8 = 15.76 \Omega$ (inductive) Ω ----1 mark,

b. impedance with respect to Frequency curve with proper labels ----2 marks



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Module 6

19. a. 4 points – 1 mark each

b. $Z = 15.62 \text{ ohm}$, Line voltage = phase voltage, Phase current = 26.56A ----2 marks,

Line current = 46.01A ----1mark, , $\text{pf}=0.833$ ----1mark, , $P= 21.17 \text{ kW}$ ----2 marks

20. a. $I_L=41.67 \text{ A}$ (2 marks), $I_{ph}=24.05 \text{ A}$ (1mark), $R=14.4\Omega$ (1mark), $X_L=8.31\Omega$ (2 marks)

b. $W_2=6.398\text{kW}$ (2), $W_1=3.601\text{kW}$ (2)

