QTQ

2009

ELECTRICAL ENGINEERING - I (Optional)

100081

Standard : Degree *Total Marks : 200*

Nature : Conventional *Duration : 3 Hours*

Note :

*(i) Answers must be written in **English**.*

*(ii) Question **No. 1** is **Compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each section**.*

*(iii) Figures to the **RIGHT** indicate marks of the respective question.*

(iv) Make suitable assumptions, wherever be necessary and state the same.

(v) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.

(vi) Credit will be given for orderly, concise and effective writing.

(vii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.

1. Answer ***any four*** of the following :

(a) A circuit having a resistance of 5 Ω , an inductance of 0.4H and a variable capacitance in series, is connected across a 110V, 50 Hz single phase supply. Calculate : **10**

(i) Value of capacitance to give resonance

(ii) Current

(iii) Voltage across the inductance

(iv) Voltage across capacitance

(v) Q factor of the circuit

(b) Describe the circuit for electrodynamometer type wattmeter and derive its torque equation. **10**

(c) Consider a N-bus system and write down the general voltage-current relationship using bus-admittance and impedance matrices. How do you get bus admittance matrix diagonal and off diagonal elements from primitive values. **10**

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(d) State the various methods used for analog to digital conversion and explain any one of them in brief with diagram. **10**

(e) Define regulation and efficiency of a transformer. State the advantages of indirect load test of transformer over direct load test of transformer to determine regulation and efficiency. **10**

SECTION - A

2. Answer the following sub-questions :

(a) Find the current through 8Ω resistor in the circuit shown in fig : Q 2(a) by Kirchhoff's Laws. **10**

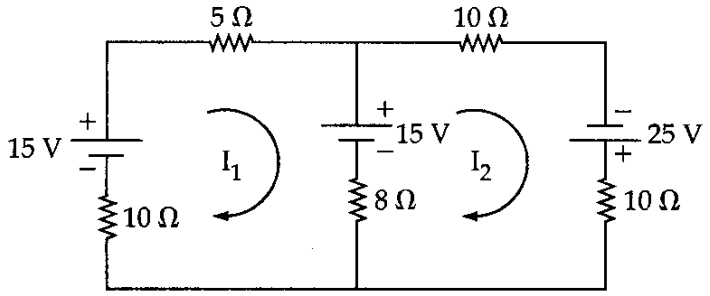

Fig. : Q 2 (a)

(b) An air line (lossless line) has characteristic impedance of 75 ohm and a phase constant of 3 rad/meter at 100 MHz. Calculate the capacitance and inductance of the line per meter. **10**

(c) (i) Draw only electrical characteristic of various d.c. motors. **5**

(ii) Explain various losses taking place in induction motor. And hence define the term "Efficiency" of induction motor. **15**

3. (a) Determine current through 8Ω branch of the circuit shown in the fig : Q 3(a) by Norton's Theorem. **10**

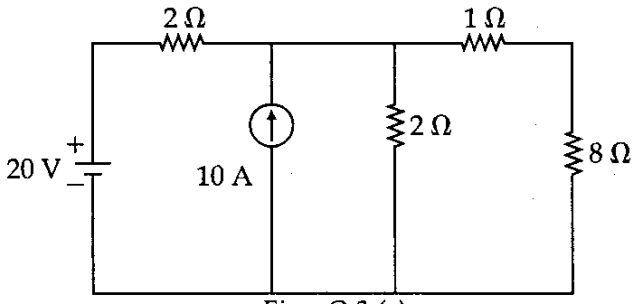

Fig. : Q 3 (a)

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(b) Find the conduction current and displacement current densities in a material having conductivity of 10^{-3} S/m and $\epsilon r = 2.5$ if the electric field in the material is $E = 5 \times 10^{-6} \sin 9 \times 10^{9}$ t V/m **10**

(c) (i) State various methods of speed control of d.c. shunt and series motors. **5**

(ii) Explain pitch factor and winding factor used in connection with alternator. Also state the formula to estimate these factor and explain various terms used in them. **15**

SECTION - B

4. (a) (i) A RLC series circuit consisting of a coil, resistance and variable capacitor connected, is tunned to resonance using Q-meter. If frequency is 500 kHz, the resistance is 0.5Ω and the variable capacitor set to 350 pF. Calculate the effective inductance and resistance of coil, if Q meter indicates 90. **5**

(ii) Describe the resistance-temperature, voltage-current, and current-time characteristics of a thermistor with the help of graphs. **5**

(b) Showing typical feedback system, enumerate the advantages of −ve feed back system. **10**

(c) A unity feedback system is characterised by a loop transfer function, **10**

$$G(s) = \frac{k}{S(S+10)}$$

Determine the value of gain k, so that the system will have a damping of 0.5. Obtain the settling time, peak overshoot, and time to reach peak over shoot for a unit step input.

(d) Obtain the transformation matrix 'p' for the state model **10**

$\dot{x} = Ax + Bx$

$y = cx$, where

$$A = \begin{bmatrix} -9 & 1 & 0 \\ -26 & 0 & 1 \\ -24 & 0 & 0 \end{bmatrix}; \quad B = \begin{bmatrix} 2 \\ 5 \\ 0 \end{bmatrix}; \quad C = [1 \;\; 2 \;\; -1]$$

5. (a) (i) With the help of neat sketch explain the working principle and its applications by using megger. **5**

(ii) A quartz pizo electric crystal having a thickness of 2 mm and voltage sensitivity of 0.055 V − m/N is subjected to a pressure of 1.5 mN/m^2. Calculate the voltage output, if the permitivity of quartz crystal material is 40.6×10^{-12} F/m, Calculate its charge sensitivity. **5**

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(b) A unity feedback system has $G(S) = \dfrac{20(1+S)}{S^2(S+2)(S+4)}$ **10**

Calculate its steady state error when applied to input

$r(t) = 40 + 2t + 5t^2$

(c) For the system characterised by the following state model **10**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = [1\ 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} ; t > 0$$

then find the transfer function of the system.

(d) Enumerate the advantages and disadvantages of P, PI, and PID controllers with suitable applications. **10**

SECTION - C

6. (a) Considering a source delivering power to remotely located load and bring out the underlying principles for active and reactive power flow. **10**

(b) Explain why the distance protection is superior to other types of protections for overhead transmission line. **15**

(c) (i) Explain the operating principles of static VAR compensator consisting of thyristor switched capacitors and thyristor controlled reactors. Point out advantages and disadvantages. **8**

(ii) Enumerate the functions of a typical load dispatch centre. **7**

7. (a) A three phase, 50 Hz , transmission line is 400 km long. The voltage at the sending end is 220kV. The line parameters are : $R = 50\ \Omega$; $x = 160\ \underline{|90°}\ \Omega$, $y = 1.12 \times 10^{-3}\ \underline{|90°}\ \Omega$. Determine sending end current and receiving end voltage, when there is no load on the line. **10**

(b) Specify an impulse voltage wave and explain how it is generated through multi-stage impulse generation. **15**

(c) (i) Consider a two area system with a tie-line and develop the mathematical model for load frequency control. State the ideal control criterion. **7**

(ii) State and explain the applications of unified power flow controller. **8**

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SECTION - D

8. (a) Draw the circuit diagram and explain wave forms of a full wave bridge type diode rectifier. **10**

(b) Draw only the characteristic of low pass, high pass filter (practical and ideal). What is the difference between active and passive filter ? Also draw only the diagram of op-amp base one pole and two pole low pass filter. **15**

(c) What is multiplexer ? With neat circuit diagram explain how 8:1 MUX is implemented by two 4:1 MUX. **15**

9. (a) With neat diagram explain various base biasing of BJT methods used in practice. **10**

(b) Explain, how op-amp can be used for sine, square and triangular wave form generator (one method each). **15**

(c) Using Boolean Algebra prove the following : **15**

(i) $\overline{\overline{A\overline{B}} + \overline{\overline{A}} + AB} = 0$

(ii) $AB + \overline{A\overline{C}} + A\overline{B}C\,(AB+C) = 1$

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