

[Time: 3 Hours]

[ Marks:80]

Please check whether you have got the right question paper.

- N.B: 1. Question 1 is compulsory.  
2. Attempt any three questions from Q.2 to Q.6.

Q1 (a) Prove  $\cosh^5 x = \cosh 5x + 5 \cosh 3x + 10 \cosh x$  (3)

(b) If  $u = \log(\tan x + \tanh y)$  (3)  
Prove  $\sin 2x \frac{\partial u}{\partial x} + \sin 2y \frac{\partial u}{\partial y} = 2$

(c) If  $u = \frac{yz}{x}$ ,  $v = \frac{zx}{y}$ ,  $w = \frac{xy}{z}$  Show that  $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$  (3)

(d) Express the following matrix as sum of symmetric and skew symmetric matrix. (3)

$$A = \begin{pmatrix} 2 & 2+i & 3 \\ -2+i & 0 & 4i \\ -i & 3-i & 1-i \end{pmatrix}$$

(e) Show that  $\log(1 + \sin x) = x - \frac{x^2}{2} + \frac{x^3}{6}$  (4)

(f) If  $y = \frac{x^2}{(x-1)(x-2)}$  Find  $y_n$  (4)

Q2 (a) Solve the Equation  $x^4 - x^3 + x^2 - x + 1 = 0$  (6)

(b) Reduce the following Matrix to the Normal form and hence find the rank of the matrix (6)

$$A = \begin{pmatrix} 6 & 1 & 3 & 8 \\ 4 & 2 & 6 & -1 \\ 10 & 3 & 9 & 7 \\ 16 & 4 & 12 & 15 \end{pmatrix}$$

(c) If  $u = \frac{x^2 y^2 z^2}{x^2 + y^2 + z^2} + \cos^{-1} \left( \frac{xy + yz}{\sqrt{x^2 + y^2 + z^2}} \right)$  (8)

Find the value of  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$



Q3 (a) (a) Investigate for what values of  $\lambda$  and  $\mu$  the system of equations  
 $x+2y+3z=4$ ,  $x+3y+4z=5$ ,  $x+3y+\lambda z=\mu$ .  
 have 1) unique solution, 2) Infinite solutions, 3) No solution (6)

(b) Find the Extreme values of  $f(x,y)=xy+a^3(\frac{1}{x}+\frac{1}{y})$  (6)

(c) Separate into real and imaginary parts of  $\tan^{-1}(e^{i\theta})$  (8)

Q4 (a) If  $u^2 + xv^2 = x + y$ ,  $v^2 + yu^2 = x - y$  Find  $\frac{\partial u}{\partial x} \frac{\partial v}{\partial y}$  (6)

(b) If  $\log \cos(x+iy) = a+ib$  Prove  $2e^{2a} = \cosh 2y + \cos 2x$  (6)

(c) Solve the following Equations by Gauss Seidel method Upto four iterations. (8)

$$4x-2y-z=40, x-6y+2z=-28, x-2y+12z=-86$$

Q5 (a) Using De Moivre's theorem Prove  
 $\cos^7 \theta = \frac{1}{2^6} (\cos 7\theta + 7 \cos 5\theta + 21 \cos 3\theta + 35 \cos \theta)$  (6)

(b) Evaluate  $\lim_{x \rightarrow 0} \left( \frac{1}{x^2} - \cot^2 x \right)$  (6)

(c) If  $y = \sin(m \sin^{-1} x)$  Prove that  $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2 - n^2)y_n = 0$   
 And hence find  $y_3(0)$ . (8)

Q6 (a) (a) Show the following vectors are linearly dependent and find the relation between them.  
 $[2, -1, 3, 2]$ ,  $[1, 3, 4, 2]$ ,  $[3, -5, 2, 2]$ . (6)

(b) If  $z=f(x,y)$  where  $x = u \cosh v$ ,  $y = u \sinh v$  Prove  
 $\left(\frac{\partial z}{\partial x}\right)^2 - \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial u}\right)^2 - \frac{1}{u^2} \left(\frac{\partial z}{\partial v}\right)^2$  (6)

(c) Fit the curve of the form  $y = ab^x$  to the following data. (8)

x	2	3	4	5	6
y	144	172.8	207.4	248.8	298.5

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TOTAL MARKS: 80

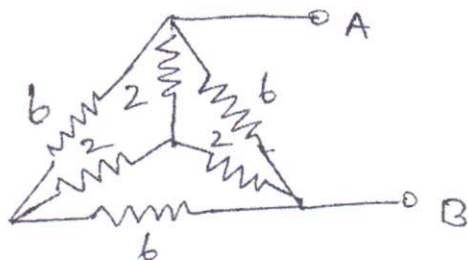
TIME: 3hrs

NB

- 1) Question No. 1 is compulsory.
- 2) Answer any three questions out of remaining five questions.
- 3) Assumption made should be clearly stated.
- 4) Answer to questions should be grouped together and written together.

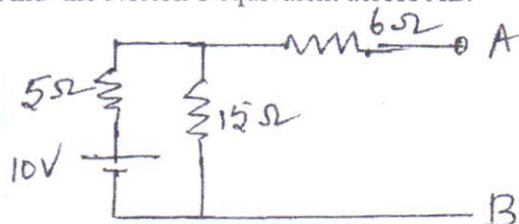
Q1 a. Find  $R_{AB}$

3



b. Find the Norton's equivalent across AB.

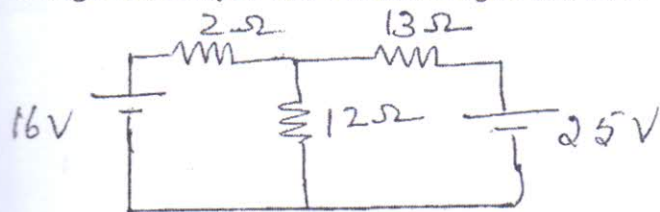
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- c. A pure inductor of 0.2 H is connected across single phase 200 V, 50 Hz supply. Write the instantaneous equation of voltage and current. 3
- d. Write any four conditions of series resonance. 3
- e. What is the phase line relation in star connected system? 2
- f. Explain the working of a single phase transformer under load 4
- g. Illustrate the working of half wave rectifier. 2

Q2 a. Using Mesh analysis find current through 2 Ω resistor.

6



- b. The impedances  $(8+j6) \Omega$  and  $(10-j10)\Omega$  are connected in parallel across voltage of  $230\angle 0$ . Determine current in each branch and kVA, kVAR, kW and power factor of the whole circuit. 8

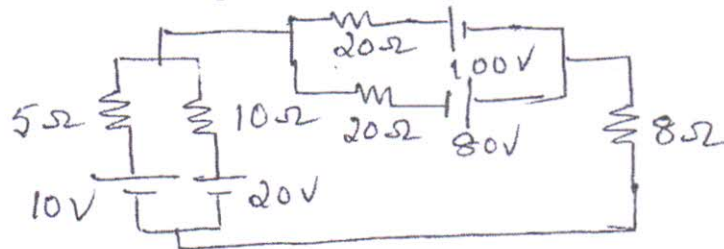
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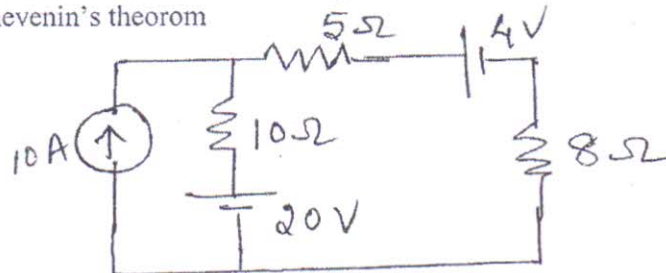
## Paper / Subject Code: 58503 / Basic Electrical &amp; Electronics Engineering.

- c. Derive emf equation of a single phase transformer 6
- Q3 a. Calculate the phase and line currents in a balanced delta connected load 8  
taking 75 kW at a power factor of 0.8 lag from a three phase 440 V  
supply. Also calculate the per phase impedance.
- b. Illustrate with neat circuit diagram the procedure for conducting open 6  
circuit test and short circuit test.
- c. Illustrate with neat diagram and explain the input characteristics of an 4  
NPN transistor in CE configuration.
- d. Draw the circuit diagram and output voltage waveform of a full wave 2  
rectifier with capacitor filter.

- Q4 a. Find current through  $8\ \Omega$  resistor using source transformation. 7



- b. Three identical coils each having a resistance of  $10\ \Omega$  and an inductive 4  
reactance of  $10\ \Omega$  are connected in star across 400 V three phase supply.  
Find the reading on each of the watt meters connected to measure the  
power
- c. Define the rms value of an ac quantity. 5
- d. Derive rectification efficiency and ripple factor of a full wave bridge 4  
tapped rectifier.
- Q5 a. Determine the current through  $8\ \Omega$  resistor in the network using 8  
Thevenin's theorem

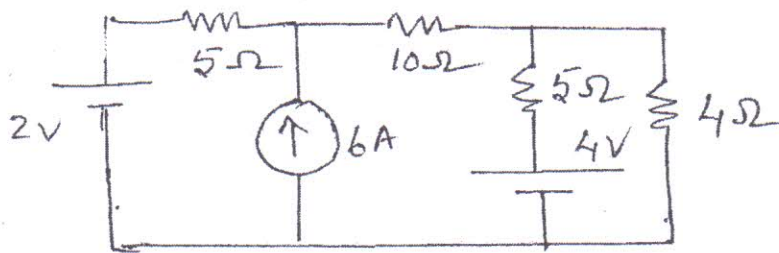


- b. An rms voltage of  $100\angle 0$  is applied to an impedance  $Z = 20\angle 30$ . Find 4  
the current through the circuit and power factor of the circuit.
- c. Derive the conditions for maximum efficiency of a single phase 8  
transformer.

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- Q6 a. Find current through  $4\ \Omega$  resistor using superposition theorem.

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- b. A series R-L-C circuit with  $R=10\ \Omega$ ,  $L=0.014\ \text{H}$  and  $C=10\ \mu\text{F}$  is connected across 230V variable frequency supply. Calculate a) resonance frequency b) current at resonance c) Q-factor d) voltage across inductor and capacitor and e) power factor at resonance.
- c. Prove that the power and power factor in a balanced three phase circuit can be calculated from the reading of two watt meters. Draw relevant connections and phasor diagram.