Duration: 3 hours **Max. Marks 80**

N. B.: 1. Question No. 1 is Compulsory.

2. Attempt any 3 Questions from Question no. 2 to 6.

3. Figures to the right indicate the full Marks.

4. Statistical tables are allowed.

Que. 1 a If λ is an eigen value of square matrix A then prove that $\frac{|A|}{\lambda}$ is an eigen value of matrix A^{-1} **5**

b A continuous random variable 'x' has probability density function $f(x) = kx^3 \quad 0 \le x \le 1$, hence find k, mean and $P(0.3 < x < 0.6)$. **5**

c Find a basis for the orthogonal complement of the subspace in R^3 spanned by the vectors $V_1 = (1, -1, 3)$, $V_2 = (5, -4, -4)$, $V_3 = (7, -6, 2)$ **5**

d Evaluate $\int_0^{1+i} z^2 dz$ along the curves i. $x^2 = y$ ii. $x = y$ **5**

Que.2. a If $A=\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ find eigen values and eigen vectors of A^2+2A+I. **6**

b Find mean and Variance of Binomial distribution **6**

c Find all Taylor and Laurent series expansions for $f(z) = \frac{1}{(z-1)(z-2)}$ about z=3 indicating the region of convergence. **8**

Que.3. a Find the curve on which the functional $\int_0^1 (y'^2 + 12xy)dx$ with $y(0) = 0$ and $y(1) = 1$ is extremal **6**

b Verify Cayley-Hamilton theorem for $A=\begin{bmatrix} 2 & -1 & 1 \\ 1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and hence find A^{-1} **6**

c Obtain the equations of the lines of regression for the following data. Also obtain the estimate of X for Y=70. **8**

X	65	66	67	67	68	69	70	72
Y	67	68	65	68	72	72	69	71

Que.4. a By using Cauchy's residue theorem, evaluate $\oint_C \frac{\sin^6 z}{(z-\pi/2)^3} dz$ where C is $|z| = 2$ **6**

b Let R^3 have the Euclidean inner product. Using Gram Schmidt process to transform the basis $\{u_1, u_2, u_3\}$ into orthonormal basis where $u_1 = (1, 1, 1), u_2 = (-1, 1, 0), u_3 = (1, 2, 1)$. **6**

c Determine whether the matrix $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ is diagonalizable, if yes diagonalise it. **8**

Que. 5 a Show that the matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ is derogatory and find the minimal polynomial of the matrix. **6**

b The weekly wages of 1000 workmen are normally distributed around a mean of Rs 70 and standard deviation Rs 5. Estimate the number of workers whose weekly wages will be (i) between 65 and 75 (ii) more than 80 (iii) estimate the lowest wages of the 100 highest paid workers. **6**

C Solve boundary value problem $y'' + y + x = 0$ $0 \le x \le 1, \quad y(0) = y(1) = 1$ by Rayleigh –Ritz method. **8**

Que.6. a If $A = \begin{bmatrix} 2 & 3 \\ -3 & -4 \end{bmatrix}$ show that $A^{50} = \begin{bmatrix} -149 & -150 \\ 150 & 151 \end{bmatrix}$ **6**

b Between 2 pm and 4 pm, the average number of phone calls per minute coming into a switchboard of a company is 1.5. Find the probability that during one particular minute there will be (i) no phone call at all, (ii) at least 2 calls. **6**

c By using Cauchy residue theorem, evaluate **8**

i. $\int_0^\infty \frac{dx}{(x^2+4)(x^2+9)}$ ii. $\int_0^{2\pi} \frac{1}{3+2\cos\theta} d\theta$

Duration 3hrs **Total Marks -80**

N.B.:- (1) Question No.**1** is compulsory.
(2) **Attempt** any **three** questions out of remaining **five** questions.
(3) Draw neat diagrams wherever it is necessary.

Q 1. Answer the following questions.

A) Compare AC and DC Supply system **05**

B) What are the factors affecting sag? **05**

C) Derive the expression for capacitance of single phase two wire transmission line **05**

D) What is Ferranti effect? **05**

Q 2 a) Draw & Explain single line diagram of structure of typical AC supply system **10**

Q 2 b) Drive the expression of string efficiency for 4 disc insulators string **10**

Q 3 a) In a string of three units, the capacitance between each link pin to earth is 11% of the capacitance of one unit. Calculate the voltage across each unit and the string efficiency when the voltage across the string is 33 kV. **10**

Q 3 b) Derive expression for inductance of single phase line having Composite conductors **10**

Q 4 a) Draw nominal π method of medium transmission line and derive the equation for sending end voltage and sending end current with phasor diagram **10**

Q 4 b) A single circuit transmission line is delivering a load of 100 MVA at 220kV and p.f. of 0.85 lagging. The line as A=D= $0.96\angle 3^0$, B=$110\angle 72^0$ ohm, C= $0.0005\angle 90^0$ siemens. Calculate sending end voltage, sending end current and sending end power **10**

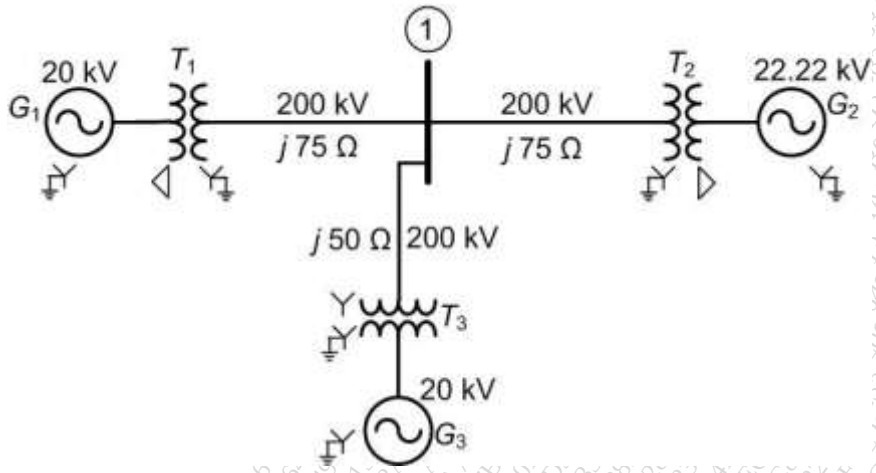
Q 5 a) State advantages and disadvantages of P.U. System & how the base quantities are selected? **10**

Q 5 b) Consider the 50 Hz power system the single-line diagram of which is shown in Fig. 1. The system contains three generators, three transformers and three transmission lines. The system ratings are **10**

Generator G_1: 200 MVA, 20 kV, X_d = 15%
Generator G_2: 300 MVA, 18 kV, X_d = 20%
Generator G_3: 300 MVA, 20 kV, X_d = 20%

Transformer T_1: 300 MVA, 220Y/22 kV, X = 10%
Transformer T_2: Three single-phase units each rated 100 MVA, 130Y/25 kV, X = 10%
Transformer T_3: 300 MVA, 220/22 kV, X = 10%

The transmission line reactances are as indicated in the figure. Draw the reactance diagram choosing the Generator 3 circuit as the base.



Q 6 a) Explain grading of cable and describe any one in detail. **10**

Q6 b) Write a note on **10**
i) Measurement earth resistance & soil resistivity
ii) Tower footing resistance

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Time: 3 Hours **Total Marks: 80**

Q.1 is compulsory.

Solve ANY THREE questions out of remaining.

ASSUME SUITABLE DATA wherever necessary.

Q.1 **(20Marks)**

a) What is voltage regulation? Derive the condition for zero voltage regulation.

b) Explain the term 'all day efficiency' in case of transformer.

c) Explain any one connection from group no. 4 and 3 of transformer phasor group.

d) Explain the methods used to suppress harmonics in three phase transformer.

Q.2 **(20Marks)**

a) Explain effect of 'incorrect phase sequence' and 'phase difference' on parallel operation of three phase transformers.

b) Two three phase transformers connected in parallel supply a load requiring an active power of 800 kW and lagging reactive power of 600 kVAR. Transformer 1 is rated at 400 KVA and has p.u. impedance of $(0.01 + j0.06)$ ohm while transformer 2 is rated at 600 KVA and has p.u. impedance of $(0.01 + j0.05)$ohm. Determine active power shared by each transformer and operating power factor.

Q.3 **(20Marks)**

a) Write a short note on 'Scott Connection'.

b) A 5 KVA, 200/100 V, 50 Hz, single phase ideal two winding transformer is to be used to step up a voltage of 200 V to 300 V by connecting it like an auto transformer. Show the connection diagram to achieve this. Calculate the maximum kVA that can be handled by the auto-transformer (without over loading any of the HV and LV coil). How much of this KVA is transferred magnetically and how much is transferred by electrical conduction?

Q.4 **(20Marks)**

a) Derive relation of length of stamping and width of stampings to diameter of circumscribing circle for maximum core area in 'Cruciform core' type construction.

b) Calculate KVA output of 1 phase transformer using following data:
ratio of core height to distance between core center is 2.8, ratio of diameter of circumscribing circle to distance between core centers is 0.56, ratio of net iron area to area of circumscribing circle is 0.7, current density 2.3 A/mm^2, window space factor 0.27, flux density = 1.2 Wb/m^2, distance between core centers = 0.4m.

Q.5 **(20Marks)**

a) Draw neat labeled phasor diagram for current transformer and potential transformer.

b) A 300 KVA, 11000/440 V, three phase transformer connected in delta-star fashion has

distance between core centers as 0.36 m, window height = 44 cm, height of yoke = 17 cm, total weight of magnetic frame = 700 Kg, average specific iron loss = 2.1 W/Kg, outer diameter of HV winding = 35 cm, resistance of LV and HV windings per phase are 0.0047 Ω and 9.74 Ω respectively. Determine number of cooling tubes required if temperature rise is not to exceed 35^0 C. Assume length wise clearance of 8cm, widthwise clearance of 10cm and height wise clearance of 45cm.

Q.6 **(20 Marks)**

a) Write short note on mechanical forces in transformer.

b) Determine main dimensions of a 1250KVA 33/6.6KV, 50 Hz, 3 phase core type power transformer based on following information

Maximum flux density=1.5 tesla, current density = 2.5 A/mm^2, window space factor=0.21, assume 3 stepped core, ratio of height of window to width of window is 3, emf per turn is 12.5V.

Duration 3hrs **Total Marks 80**

NB:- 1)Question No. 1 is Compulsory.
2) Attempt any three Questions out of remaining five Questions.
3) Assume suitable data if necessary and justify the same.

Q.1 **Answer any four out of five questions**.

a Explain Coulomb's law in Electrostatics and hence define Unit Charge. **05**

b Express the following vector in Cartesian co-ordinate system **05**
A=2 cos θ âr +3 r âθ - 4 âz

c State and explain relationship between Electric Intensity and potential. **05**

d What is Lorentz force equation for moving charge? Enlist two applications. **05**

e Explain inconsistency in Ampere's circuital law **05**

Q2 **a** Show that electric field due to infinite sheet of charge at a point is independent of distance at that point from the plane containing the charge. **10**

b Three equal point charges of 2 µc are in free space at (0,0,0), (2,0,0), (0,2,0) respectively . Find net force on fourth charge of 5µC at (2,2,0) **10**

Q3 **a** Derive Poission's and Laplace equation. Two plates of a parallel capacitors are separated by a distance 'd 'and maintained at potential **0** and $\mathbf{V_1}$ respectively. Find potential at any point between plates. **10**

b Derive the set of Maxwell's equation for Static field and Time varying field **10**

Q4 **a** Explain Ampere circutal law and differentiate between conduction current and displacement current **10**

b Find the capacitance of a co-axial conductor of length L, where inner and outer radius are r1 and r2 respectively **10**

Q5 **a** A current sheet $K^- = 10$ âz A/m lies in X=4 m plane and a second sheet $K^- = -8$ âz A/m is at X= - 5 m plane. Find H^- at points (i) (1,1,1) (ii) (0, -3, 10) **10**

b Derive magnetic field intensity due to finite and infinite wire carrying a current I. **10**

Q6 **a** Formulate the wave equation from Maxwell's equations for perfectly conducting medium **10**

b Consider an interphase in Y- Z plane .The region X < 0 is medium1 with $\mu_{r\,1} = 4.5$ and magnetic field, **H**= 4 â x+5 â y- 6 â z A/m. The region X > 0 is medium 2 with $\mu_{r2} = 6$. Find $\mathbf{H}_2$ and $\mathbf{B}_2$ in medium 2 and also calculate the angle made by $\mathbf{H}_2$ with normal to interface. **10**

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(3 Hours) **[Total Marks:80]**

N.B. **(1)** Question no.1 is compulsory.
(2) Attempt any three from the remaining.
(3) Numbers to the right indicate full marks to that question

Q.1 Answer any **Four** from the following. 20

(a) Compare ideal and practical values of op-amp parameters.

(b) Draw and explain frequency response of op-amp.

(c) Derive expression for voltage gain of op-amp in non-inverting mode with feedback.

(d) i) Perform binary subtraction using 2's complement for decimal numbers.
$(45)_{10} - (27)_{10}$
ii) Convert the following:
(A) $(B8AF.\ E6)_{16}$ to decimal
(B) $(1101111001.101)_2$ to octal

(e) Simplify the Boolean expression and implement using gates
$Y = AB\overline{C} + (\overline{\overline{AC}} + B) + A\overline{C} + AB + (\overline{A + \overline{BC}})$

Q.2 **(a)** Draw and explain operation of Schmitt Trigger with circuit diagram and waveforms. 10

(b) With neat functional block diagram and waveforms, explain operation of IC 555 timer as astable multiviberator. Derive expression for output frequency and duty cycle. 10

Q.3 **(a)** Design and implement 4 bit gray to binary code converter. 10

(b) Simplify the following function using K-map and implement using NAND gates 10
f(A,B,C,D) = Σ m (1,3,5,9,11,12,13,15) + d(4,6,8,10,14)

Q.4 **(a)** Draw and explain operation of sample and hold circuit using op-amp with waveforms. 10

(b) Design mod-8 synchronous up counter using JK flip flops. 10

Q.5 **(a)** Convert: i) JK Flip flop to T Flip flop 10
ii) SR to JK flip flop

(b) Implement the following function using one 8:1 multiplexer and two 4:1 multiplexer. *f(A,B,C,D) = ∑m(0,2,5,6,8,9,12,13,15)* 10

Q.6 **(a)** Explain operation of basic voltage regulator circuit. Compare the linear and switching type regulators. 10

(b) Define the characteristics of digital IC's. Explain interfacing of TTL and CMOS logic families.

[3 Hours] Maximum Marks: 80

Note: i) Question No. 1 is Compulsory
Ii) Attempt Any Three questions from remaining
Iii) Assume suitable data if necessary

1. Attempt the following: (20)
   a) Find the condition of reciprocity for Transmission parameters.
   b) Define Transfer Function of a Network. What are the restrictions on Poles and Zeros location for transfer function?
   c) Write the mesh equations for the circuit shown in fig (a).
   d) For network given in fig (b) write:
      i) Incidence Matrix ii) f-Cutset Matrix iii) Tieset Matrix

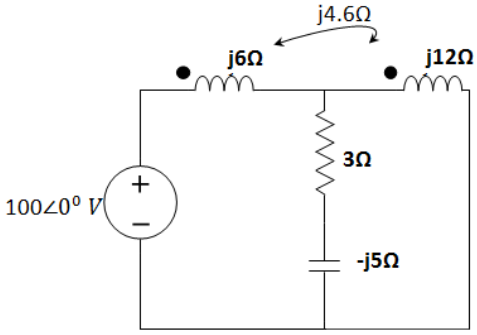

Fig (a)

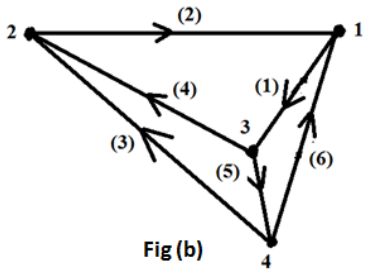

Fig (b)

2. A) Calculate value of R_L for fig (c) getting maximum power. Also calculate Maximum Power. (10)

   B) The network in fig (d) has acquired steady state before switching at $t = 0$.
   i) Obtain $v_c(0^+)$, $v_c(0^-)$, $i(0^+)$ and $i(0^-)$
   ii) Obtain time constant for $t > 0$ iii) Find current $i(t)$ for $t > 0$ (10)

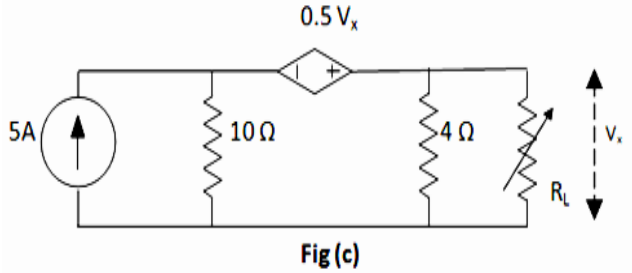

Fig (c)

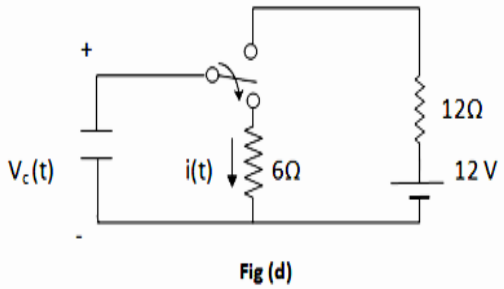

Fig (d)

3. A) The circuit given in fig (e) is in steady state with S_1 closed and S_2 open. At $t = 0$, S_1 is opened and S_2 is closed. Find current through the capacitor. (10)

B) Find Y –parameters for the network shown in fig (f). (10)

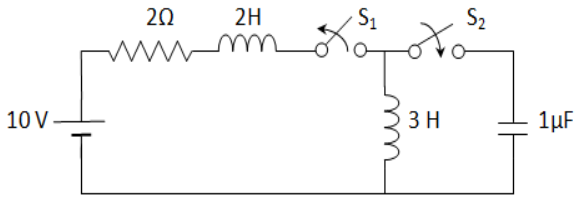

Fig (e)

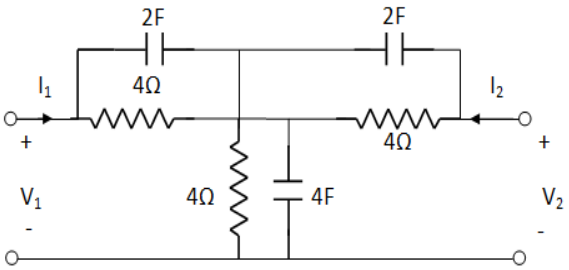

Fig (f)

4. A) For given network and pole zero diagrams for driving-point impedance $Z(s)$ are shown below.

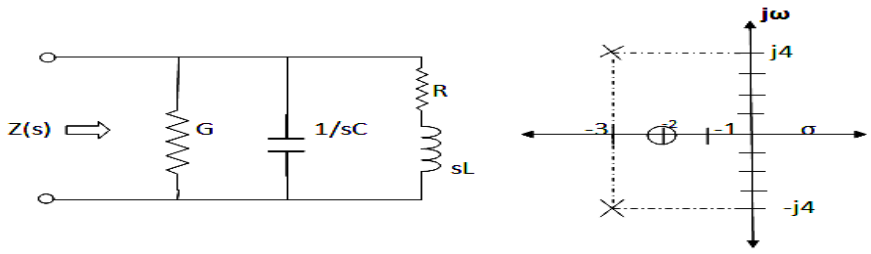

Fig (g)

Calculate the value of R,L, G and C if $Z(j0) = 1$. (10)

B) Find Voltage across 5 ohms resistor using Mesh analysis. (10)

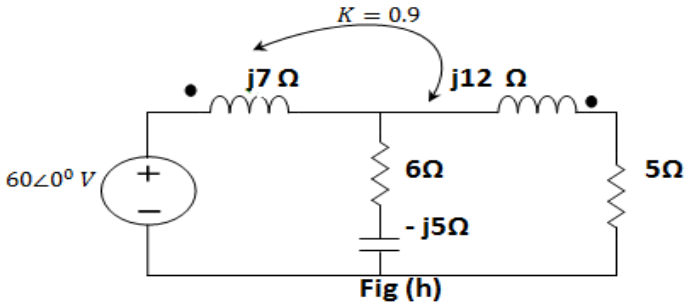

Fig (h)

5. A) For the given network, mention tieset matrix and obtain the network equilibrium equations in matrix form using KVL. (10)

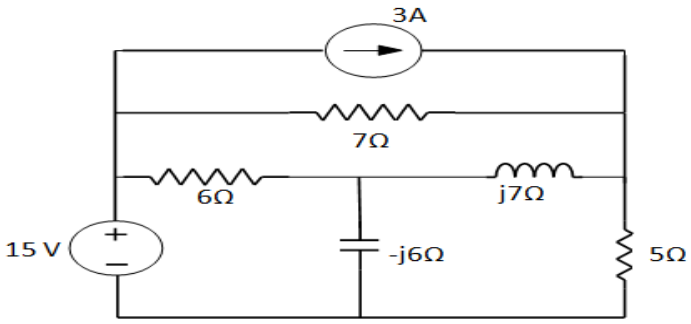

Fig (i)

B) At $t = 0$, unit pulse voltage of unit width is applied to a series RL circuit as shown in fig (j). Obtain an expression for i(t). (6)

C) Draw dual of the network shown in fig (k). (4)

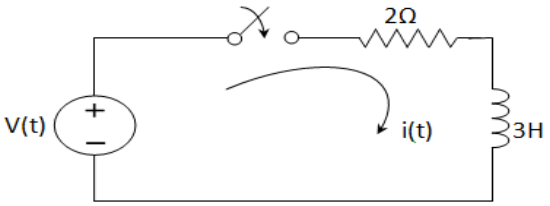

Fig (j)

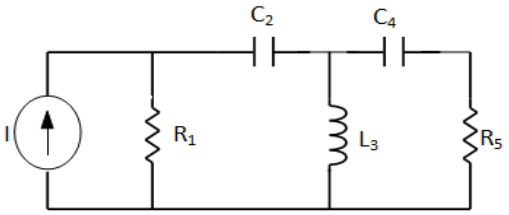

Fig (k)

6. A) Using superposition theorem, find current 'I' through circuit shown in fig (l). (6)

B) In the given fig (m), at $t = 0$ switch is opened. Calculate $v, \frac{dv}{dt}$ and $\frac{d^2v}{dt^2}$ at $t = 0^+$. (8)

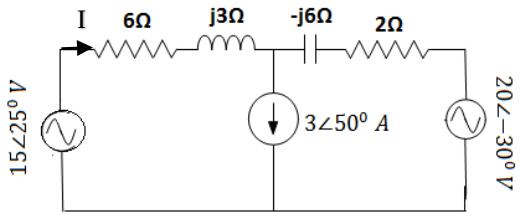

Fig (l)

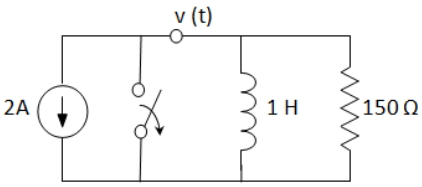

Fig (m)

C) The current $I(s)$ in a network is given by: (6)

$$I(s) = \frac{4S}{(S+2)(S+4)}$$

Plot pole-Zero pattern in the S-plane and obtain $i(t)$.

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