Q.P. Code: 37581

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

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 λ^n is an eigen value of square matrix A^n. 5

b A Continuous random variable X has a probability density function $f(x) = kx^2e^{-x}, \quad x \geq 0$. Find k, mean and variance. 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 the complex line Integral $\int_0^{1+i} (x - y + ix^2)dz$ along the straight line from z=0 to z=1+i 5

Que.2. a Find the curve y=f(x) for which $\int_{x_1}^{x_2} y\sqrt{1+y'^2}\,dx$ is minimum subject to the constraint $\int_{x_1}^{x_2} \sqrt{1+y'^2}\,dx = l$. 6

b Seven dice are thrown 729 times . How many times do you expect at least 4 dice to show 3 or 5 ? 6

c Find all Taylor and Laurent series expansions for $f(z) = \frac{z}{(z-3)(z-4)}$ about z=1 indicating the region of convergence. 8

Que.3. a Find the expectation of (i) the sum (ii) the product of the number of points on the throw of n dice. 6

b Verify Cayley-Hamilton theorem for A= $\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ 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 Using Reyleigh-Ritz method, solve the boundary value problem 6

$I = \int_0^1 (y'^2 - y^2 - 2xy)dx; \quad 0 \le x \le 1$. Given y(0)=0 and y(1)=0

b Construct an orthonormal basis of R^3 using Gram Schmidt process to S={(3, 1, 4), (-1, 0, 7), (2, 9, 11)} 6

c Determine whether the matrix $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$ is diagonalizable, if yes diagonalise it. 8

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

b Three factories A, B, and C produces 30%, 50% and 20% of the total production of an item. Out of their production 8%, 5% and 1% are defective. Find probability that defective item is produced by factory A 6

c Of a group of men 5% are under 60 inches height and 40% are between 60 and 65 inches. Assuming a normal distribution find the mean height and standard deviation. 8

Que.6. a If $A = \begin{bmatrix} \pi/2 & \pi \\ 0 & 3\pi/2 \end{bmatrix}$, Find sin A 6

b An insurance company found that only 0.01% of the population is involved in a certain type of accident each year. If its 1000 policy holders were randomly selected from the population, what is the probability that not more than two of its clients are involved in such accident next year. 6

c By using Cauchy residue theorem, evaluate 8

i. $\int_0^\infty \frac{dx}{x^2+9}$ ii. $\int_0^{2\pi} \frac{1}{5+4\cos\theta} d\theta$

Q.P. Code: 38444

[Time: Three Hours] **[Marks:80]**

Note:
1. **Question No. 1 is compulsory.**
2. **Attempt any 3 questions from the remaining five questions.**
3. **Figures to the right indicate full marks.**
4. **Make suitable assumptions wherever necessary**

Q.1 a) Draw basic structure of power system. (5)

b) Explain effect of ice and wind loading on sag. (5)

c) Describe skin effect and proximity effect. (5)

d) Explain step and touch potential. (5)

Q.2 a) What is string efficiency? Explain methods of improving string efficiency (10)

b) Derive expression for inductance of 3-phase line with symmetrical and unsymmetrical spacing (10)

Q.3 a) Find the maximum sag of a line with copper conductor of 7/0/295 cm size, area 0.484 cm^2, over all diameter 0.889 cm, weight 428 kg/km and breaking strength 1973 kg. Use a safety factor of 2, span 200 m and level supports.
(i) due to weight of conductor (ii) due to additional weight of ice loading of 1 cm thickness. (10)

b) Derive expression for capacitance of single phase line for (i) without effect of earth and (ii) with effect of earth. (10)

Q.4 a) Derive ABCD constants for medium transmission line considering nominal T circuit and nominal π circuit. (10)

b) A 3-phase 132 kV, 100 km, 50 Hz, single circuit line has horizontal spacing with 3.5 m between adjacent conductors. The conductor diameter is 1.2 cm. Calculate
i) Loop inductance per phase per km, ii) line to line capacitance per phase per km, iii) line to neutral capacitance per phase per km ,iv) charging current per phase, and v) charging MVA (10)

Q. 5 a) A 300 km, 132kV, 3-phase overhead line has a total series impedance of 52 + j 200 ohms per phase and a total shunt admittance of j 1.5×10^{-3} siemens per phase to neutral.

The line is supplying 40 MVA at 0.8 pf lagging at 132 kV. Find i) ABCD constants and ii) line to line sending end voltage considering nominal π circuit. (10)

b) Fig 01 shows a single line diagram of a power system. Draw impedance diagram. Choose a base of 100 MVA, 220 kV in 50 ohm line. Ratings of equipment are: (10)

Generator: 40 MVA, 25 kV, X''= 20%

Syn motor: 50 MVA, 11 kV, X'' = 30 %

Y-Y transformer: 40 MVA, 33/220kV, X = 15%

Y-Δ transformer: 30 MVA , 11/220 kV, X= 15%

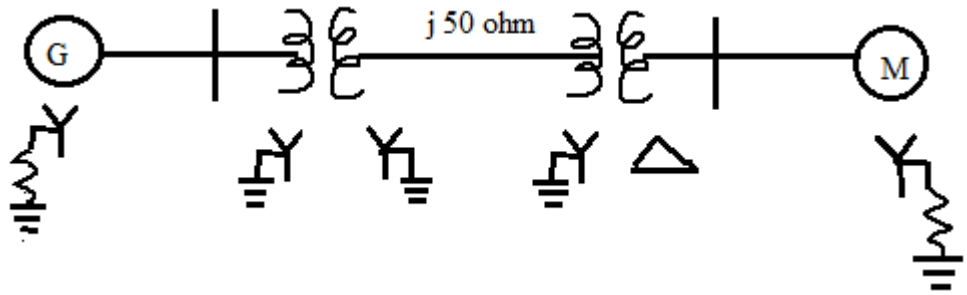

Fig.01

Q.6 a) Explain grading of underground cables (10)

b) Explain methods of neutral grounding (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) Make any suitable assumption wherever required.

Q.1 Answer any **four**.

(a) Explain properties of magnetic materials required for electrical machine design. 5M
(b) Explain saving of copper in autotransformer over two winding transformer. 5M
(c) Explain the conditions for parallel operation of three phase transformer. 5M
(d) Explain disadvantages of harmonics in transformer. 5M
(e) Explain Burden of potential transformer 5M

Q.2 **(a)** Draw and explain back to back test. 10M
(b) Two single phase transformers A and B rated at 600KVA and 500KVA resp. are operated in parallel to supply a load of 1000KVA at 0.8 lagging power factor. The resistance and reactance of transformer A are 3% and 6.5% while that of transformer B are 1.5% and 8%. Calculate the KVA loading and the power factor at which each transformer operate. 10M

Q.3 **(a)** Explain excitation phenomenon in three phase transformer. 10M
(b) Calculate the no load current of a 400V, 50 Hz, single phase core type transformer having the following data: 10M
Stacking factor = 0.9, density = 7.8×10^3 kg/m^3, length of mean flux path = 2.2 m, gross iron section = 10×10^{-3}m^2, primary turns = 200, joints equivalent to 0.2 mm air gap. Assume mmf/meter = 210 A/m, Iron loss per kg = 1.3W/kg for the corresponding flux density of 1Wb/mm^2.

Q.4 **(a)** Derive an output equation of a three phase core transformer. 10M
(b) Determine the dimensions of core and yoke for a 200KVA, 50Hz single phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn 14V, maximum flux density 1.1Wb/m^2, window space factor 0.32, current density 3A/mm^2 and stacking factor = 0.9. The net iron area is $0.56d^2$ in a cruciform core where d is the diameter of circumscribing circle. Also the width of largest stamping is 0.85d. 10M

Q.5 **(a)** Explain 'Oscillating Neutral'. 10M
(b) A 300 KVA, 6600/400V, 50 Hz, delta/star three phase core type transformer has the following data: Width of hv winding = 25mm, Width of lv winding = 16mm, height of coils =0.5m, length of mean turn =0.9m, hv winding turns=830, width of duct between hv and lv winding =15mm, calculate the leakage reactance of the transformer referred to the hv side. If the lv coil is split in to two parts with one part on each side of the hv coil, calculate leakage reactance referred to hv side. Assume that there is a duct 15mm wide between hv winding and each part of lv winding. 10M

Q.6 **(a)** Draw and explain Scott connection. What are the applications of Scott connection? 10M
(b) Explain various cooling methods in transformer. 10M

Q.P.Code: 38366

Duration: 3Hrs **Marks: 80**

Note: (1) Question No:1 is compulsory

(2) Attempt any three question from the remaining questions.

Q1. Solve any four from the remaining question. **(20)**

(a) State and explain Biot-Savart law.

(b) Explain current density and continuity equation.

(c) Convert P (10,π/6,π/3) in cylindrical co-ordinates.

(d) Justify the statement "Divergence of a curl of a quantity is zero".

(e) Enlist five properties of electromagnetic wave.

Q2. (a) Evaluate both sides of divergence theorem for $D = x^2a_x + y^2a_y + z^2a_z$ over the cube $0<x,y,z<1$. **(10)**

(b) Two uniform line charges of density 8.854nC/m are located in a plane z=0 at y =±6m. **(10)**
Find the E field at a point P (0, 0, 6).

Q3. (a) Derive Maxwell's equation in integral and point form for time varying field. **(10)**

(b) Derive the electric field intensity due to a infinite line charge. **(10)**

Q4. (a) Derive the Poisson's and Laplace equation. In Cartesian co-ordinates a potential is a function of x only. At X = -20cm, V=25V and $\mathbf{E} = -1.5 \times 10^3\ \mathbf{a_x}$ V/m throughout the region. Find V at X = 3 cm. **(10)**

(b) A charge distribution in free space has $\rho_v = 2r\ nC/m^3$ in spherical co-ordinates, for $0<r<10$ m and zero otherwise. Determine **E** at r = 2m and r = 12m. **(10)**

Q5. (a) Given that $\mathbf{H} = \mathbf{H_m}\, e^{j(\omega t + \beta z)}\, \mathbf{a_x}$ (A/m) in free space, Find **E**. **(10)**

(b) A dielectric free space interface has the equation 3X + 2Y +Z = 12m. The origin side of the interface has $\epsilon_{r1} = 3$ and $\mathbf{E_1} = 2\mathbf{a_x} + 5\mathbf{a_z}$ (V/m). Find $\mathbf{E_2}$. **(10)**

Q6. (a) Transform given vector A in to cylindrical system $\mathbf{A} = y\mathbf{a_x} + x\mathbf{a_y} + \frac{x^2}{\sqrt{x^2+y^2}}\mathbf{a_z}$. **(10)**

(b) Starting from Maxwell equation obtain wave equation for the field E and H for free space. **(10)**

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(3 Hours) [Total Marks :- 80]

Instructions: 1. Question No. 1 is compulsory
2. Attempt any **three** questions out of remaining **five** questions
3. Figures to the right indicates marks
4. Assumptions made should be clearly stated

Q.1 Attempt **any five** from following

(a) Define input offset voltage and input offset current for an op-amp. State their ideal and practical values. [4]

(b) Illustrate operation of op-amp as a voltage follower. [4]

(c) Draw block diagram of op-amp and explain its operation. [4]

(d) Prove universality of *NAND* gate for *NOT* gate and *AND* gate. [4]

(e) Convert: (i) $(1085)_{10}$ to octal (ii) $(AB86.43)_{16}$ to decimal [4]

(f) Convert JK flip flop to T flip flop. [4]

Q.2. (a) With circuit diagram, explain the operation of op-amp as Schmitt trigger and draw its input and output waveforms. [10]

(b) Illustrate the operation IC 555 as astable multivibrator using functional block diagram and derive the expression for frequency and duty cycle. [10]

Q.3. (a) Design and implement full adder using 8:1 and 4:1 multiplexer. [10]

(b) Illustrate operation of op-amp as V to I and I to V converter. [10]

Q.4. (a) Explain first order low pass filter using op-amp with its frequency response. [10]

(b) (i) Simplify the following Boolean expression and implement using basic gates [05]

$$ABC + \overline{AB} + AB\overline{C} + AC + \overline{\overline{AB}}$$

ii) Write a short note on TTL and CMOS logic families. [05]

Q..5.(a) Minimize the expression using K-map & implement it using NAND gate [10]
$f=\sum m(2,3,6,7,8,9,12,13)+d(0,1,10,11)$

(b) Design and implement mod-8 ripple down counter using JK flip flops. [10]

Q..6 (a) Illustrate operation of op-amp as optical isolation amplifier. [10]

(b) (i) What are adjustable voltage regulators? [05]

ii) Explain ring counter. [05]

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

N.B.: (1) Question No. **1** is **compulsory.**
(2) Answer any **three** from the remaining **five** questions.
(3) **Assume** suitable **data** if necessary and justify the same.

1. Answer **any four**. **[20]**

(a) Define the terms oriented graph, tree and loop.

(b) Using Laplace transform, obtain the expression for current in impure inductor when a unit ramp signal is applied.

(c) Derive the condition for reciprocity in transmission parameters.

(d) State the various properties of LC driving point function.

(e) Using superposition theorem, find current I_x of network given in Fig.1

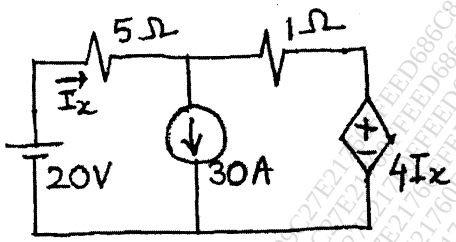

Fig. 1

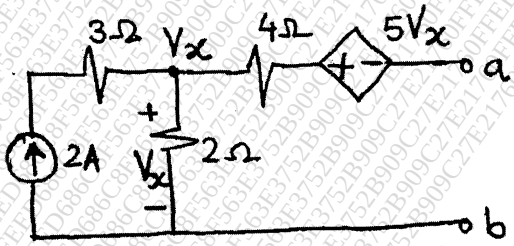

Fig. 2

Q2a Obtain Thevenin's equivalent of network shown in Fig. 2 **[8]**

Q2b For the graph shown in Fig. 3, write the tieset matrix and f-cutset matrix. **[8]**

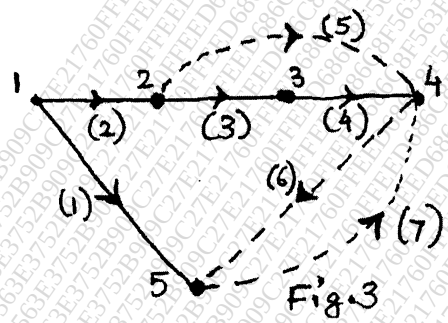

Fig. 3

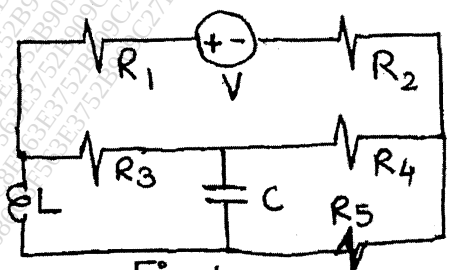

Fig. 4

Q2c Draw the dual of the network shown in Fig. 4 **[4]**

Q3a Explain the concept of super mesh and super node with an example. **[5]**

Q3b Write the mesh equations for the circuit shown in Fig. 5 **[5]**

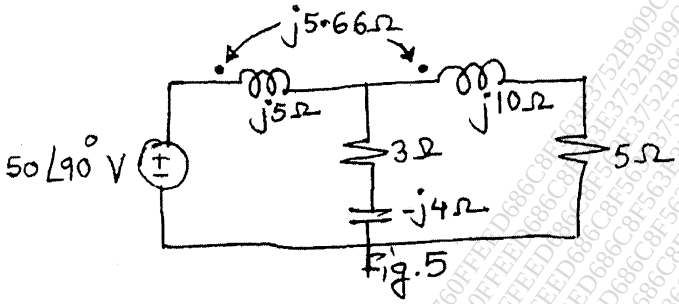

Fig.5

(c) For the network shown in Fig.6, steady state is reached with the switch closed. The switch is opened at t = 0. Obtain expressions for $i_L(t)$ and $v_L(t)$. **[10]**

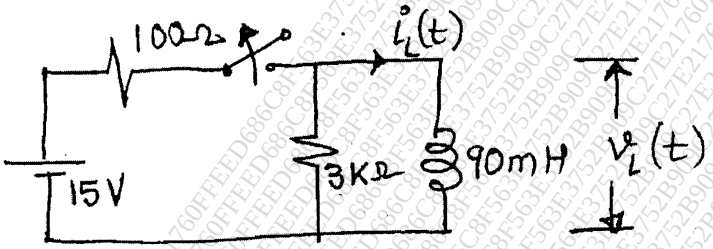

Fig. 6

Q4a Using differential method, derive the expression for current in a series RL circuit. Draw its characteristics and define time constant. **[6]**

Q4b Mention the restrictions on pole and zero locations for driving - point functions. **[4]**

Q4c Find the current I in the network shown in Fig.7, using superposition theorem **[10]**

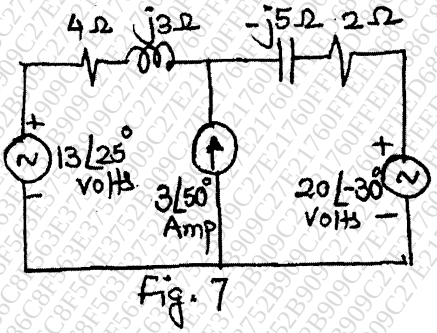

Fig. 7

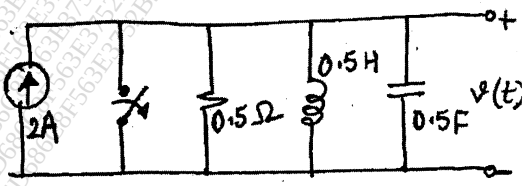

Fig. 8

Q5a The network shown in Fig.8 has acquired steady state at t < 0 with the switch closed. The switch is opened at t = 0. Determine v(t). **[10]**

Q5b For the network shown in Fig.9, find Z and h – parameters. **[10]**

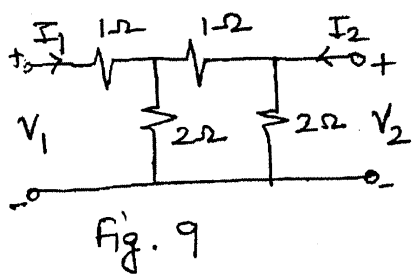

Fig. 9

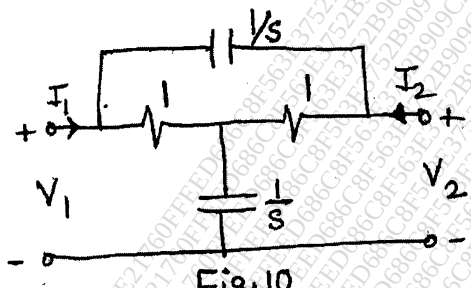

Fig. 10

Q6a Find the short circuit parameters for the network shown in Fig 10. **[10]**

Q6b The voltage V(s) of a network is given by $V(s) = \frac{3s}{(s+2)(s^2+2S+2)}$. Plot its pole – zero diagram and hence obtain v(t) using graphical method. **[10]**