Time: 3 hrs. **Total Marks:80**

N.B.(1) Question No.1 is compulsory.

(2) Attempt any three from the remaining questions

(3)Assumptions made should be clearly stated.

(4) Figure to the right indicates full Marks.

Q1	Attempt any four	20 Marks
a.	State the advantages of keeping armature stationary in synchronous machine.	5
b.	Elaborate classification of synchronous machine on the basis of rotor construction.	5
c.	What is Armature Reaction? Explain the effect of Armature reaction on the terminal voltage of Alternator at unity power factor load.	5
d.	"Synchronous Motor is not self starting" Justify the statement	5
e.	Draw P-ɗ curve for salient pole alternator with active power equation.	5
Q2.		
a.	Derive the expression for EMF induced in alternator.	10
b.	A 3-phase, 50 Hz alternator is running at 600 rpm has a 2-layer winding, 12 turns/coil, 4 slots/pole/phase, and coil-pitch of 10 slots. Let us find the induced EMF per phase if the flux/pole is 0.035 webers.	10
Q3.		
a.	Illustrate MMF method with advantages and limitations.	10
b.	Derive the expression for pitch factor and distribution factor and derive formula for Kp and Kd.	10
Q4.		
a.	Two station alternators A and B operate in parallel. The Station capacity of A is 30 MW and that of B is 60 MW. The full-load speed regulation of station A is 4% and full-load speed regulation of B is 4.5%. Calculate the load sharing if the connected load is 60 MW. No-load frequency is 50 Hz.	10
b.	State and explain conditions for satisfactory synchronisation with grid.	10

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Q5.

a. Elaborate 'V' and 'inverted V' curve in synchronous motor. 10

b. State various starting methods of synchronous motor and explain any one in brief

Q6

a. Explain steady state analysis 3 phase synchronous machine. 10

b. Elaborate slip test on synchronous machine and comment on direct and quadrature axis reactance. 10

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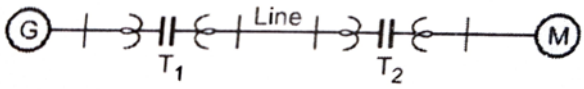
Duration – 3 Hours **Total Marks assigned to the paper- 80**

N.B.: - (1) Question No.1 is compulsory.
(2) Attempt any Three questions out of the remaining five questions.
(3) Assume suitable data if necessary and justify the same.

Q 1. **Answer all questions**.

A) Explain the terms short circuit MVA and symmetrical fault. **05**
B) Discuss the role of bundled conductors in corona. **05**
C) Differentiate between symmetrical and unsymmetrical faults. **05**
D) Explain various rules used in the formation of sequence networks of power systems.

Q 2 a) Illustrate the short circuit of synchronous machine at no load condition. **10**
Q 2 b) A synchronous generator and synchronous motor each rated at 25 MVA and 11kV having 15% subtransient reactance are connected through transformer and line as shown. The transformer is rated for 25 MVA,11/66kV and 66/11kV with leakage reactance of 10%.The line has reactance of 10% on the base of 25MVA and 66 KV. The motor is drawing 15MW at 0.8 pf leading and terminal voltage is 10.6 kV. When a symmetrical three phase fault occurs at the terminal of motor. Determine the subtransient current in generator, motor and fault. **10**



Q 3 a) Discuss the phase shift of symmetrical components in star delta transformer. **10**
Q 3 b) Derive the equation for fault current and sequence network for double line to ground fault. State the various assumptions in calculation. **10**

Q 4 a) A 25 MVA,13.2 kV alternator with solidly grounded neutral has subtransient reactance of 0.25 pu. The negative and zero sequence reactances are 0.35 and 0.1 pu respectively. A single line to ground fault occurs at the terminals of an unloaded alternator. Determine the fault current and line to line voltages.(Neglect resistance) **10**
Q 4 b) Describe the generation of voltage and current travelling waves on a open circuited line with figure and equations. **10**

Q 5 a) Calculate an arrestor's voltage and current rating if it is placed at the end of a line and at the junction of two lines. Draw the equivalent circuit for the same. **10**
Q 5 b) Discuss the generation and formation of corona rings and corona pulses in EHV lines. **10**

Q 6 a) Describe the algorithm for short circuit studies. **10**
Q 6 b) Explain the following (i) Fortescue theorem (ii) volt time curves **10**

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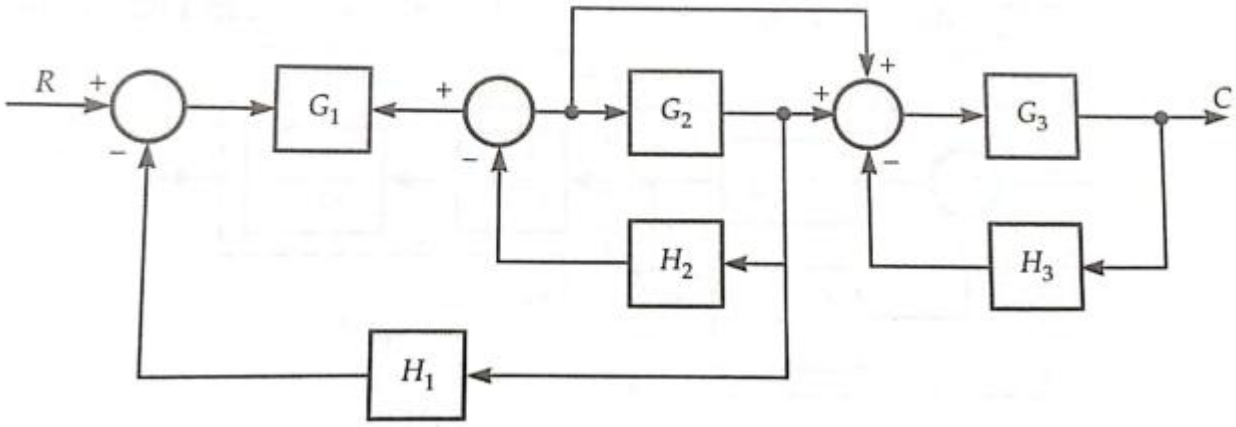
Time (3 Hours) **80 Marks**

Note: (1) Question no. 1 compulsory
(2) Attempt any 3 question out of remaining five questions.
(3) Draw neat diagram wherever necessary.

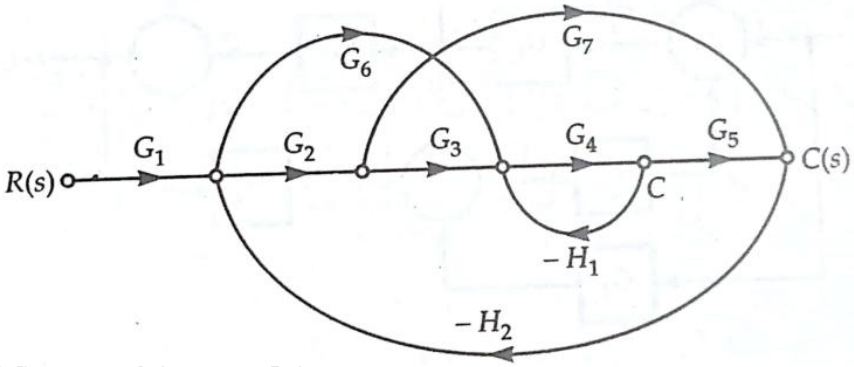
Q 1. Attempt any Four out of five questions

a. Consider an open loop system, G(s) H(s) = $\frac{k}{s^3 + 4s^2 + 8s}$. Check whether s = -1.33 + j 0.94 point lies on the root locus or not using angle condition in root locus.
b. Explain the stability conditions of Bode plot by using suitable diagrams.
c. Explain the general representation of state space model with example.
d. Explain the term damping ratio. Also explain the conditions for the damping ratio.
e. Explain force current analogy in mathematical modeling of control system.

Q 2. a. Obtain the transfer function for the following figure using Block Diagram Reduction method.



b. Obtain the transfer function C(s)/R(s)for the following figure using Mason's gain formula.



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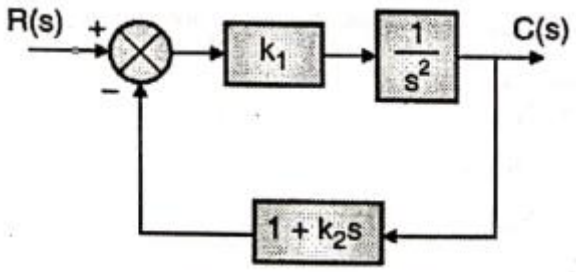
Q3. a. Given the unity feedback system that has the forward transfer function G(s) = $\frac{k(s+2)}{s\,(s^2+4s+13)}$. Sketch the complete root locus.

b. Determine the stability of a system having the characteristics equation using Routh-Hurwitz criteria: $s^6 + 5s^5 + 11s^4 + 25s^3 + 36s^2 + 30s + 36 = 0$ find the stability of the system using Routh Hurwitz criteria.

Q4. a. A feedback control system has G(s) H(s) =$\frac{k}{s(s+2)(s+10)}$Draw Bode plot and comment on stability.

b. For a control system, find the values of K_1 and K_2 so that Mp = 25% and Tp = 4 sec. Assume step input. Also find (1) Settling time (2) Rise time.



Q5. a. Explain the closed loop system. Also, compare the open loop and closed loop system for any control system.

b. Represent the following state space equation in phase variable form and also draw its state model $\frac{C(s)}{R(s)} = \frac{20\,(s+1)(s+3)}{(s+1)(s+5)(s+7)}$

Q 6 a. The control system having unity feedback has G(s) = = $\frac{20}{s\,(1+4s)\,(1+s)}$. Determine: (1) Type of system. (2) Static error constants. (3) Steady state error for the input r(t) = $2 + 4t + \frac{t^2}{2}$

b. Explain armature controlled DC servomotor and also draw the block diagram.

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Duration – 3 Hours **Total Marks assigned to the paper- 80**

N.B.: - (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. **Each questions carry 5 marks. Attempt any four questions.**

a. Prove that 'The line integral of the magnetic field around some closed loop is equal to the sum of the currents which pass through the loop'. **05**

b. Explain Lorentz's force equation for moving charge. Enlist its application. **05**

c. Enlist any five properties of Electromagnetic waves. **05**

d. Point charge Q=0.5 μC placed at origin, find electric field intensity at (0,3,4)m . **05**

e. Define gradient operator. Derive the relation between $\bar{E}$ and the electric potential. **05**

Q 2 a) Define magnetic Potential. State how is magnetic potential analogous to electric potential? General vector potential $\bar{A}$=10sinθ $\overline{a_\theta}$, in spherical system. Find magnetic flux density $\bar{B}$ at (2,π/2,0) **10**

Q 2 b) Formulate wave equation from Maxwell's equation. Solve it for perfectly conducting media. **10**

Q 3 a) An infinite long current filament is placed along z-axis. The magnetic field intensity at point P(6,8,0) is 10 (-1.6$\overline{a_x}$,+1.2$\overline{a_y}$) A/m. Find current through the filament. **10**

Q 3 b) Derive the expression for magnetic field intensity due to finite and infinite wire carrying current I. **10**

Q 4 a) Derive Maxwell's second equation in integral and point form. **10**

Q 4 b) Find $\bar{D}, \bar{B}$ *and* $\bar{H}$ displacement current density in free space, given $\bar{E} = E_m \sin(\omega t - \beta z)\overline{a_y}$. **10**

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Q 5 a) Discuss the phenomenon of electric polarization in dielectric medium. **10**

Q 5 b) Derive the Poisson's and Laplace equation. In Cartesian co-ordinate a potential is a function of x only. At $x = -2\ cm, V = 25\ V\ and\ E = -1.5 \times 10^3 \overline{a_x}\ V/m$ throughout the region. Find V at x=5 cm. **10**

Q 6 a) Derive electric field intensity due to an infinite plane having density $\rho_s \left(C/m^2\right)$. **10**

Q 6 b) State & explain coulomb's law in electrostatics. **10**

A Charge $Q_1 = -20\mu C$ is placed at P(-6,4,6) m and a charge $Q_2 = 50\mu C$ is placed at R(5,8,-2) m in free space. Calculate the exerted force on $Q_2 by\ Q_1$ in vector form.

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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) Figures to the right indicate full marks
(4) Assume suitable data if necessary

1.	(a)	Explain the working of fuel cell.	**20**
	(b)	Discuss the wind turbine characteristics.	
	(c)	Discuss the importance of MPPT in stand-alone PV system.	
	(d)	Explain biogas power plant.	
2.	(a)	Discuss the working principle of solar concentrators.	**10**
	(b)	Explain in brief the power converter topology used in Doubly Fed Induction Generator (DFIG) based WES.	**10**
3.	(a)	Explain any one MPPT algorithm with its block diagram.	**10**
	(b)	What are the different types of fuel cells available? Discuss the features of each with neat figures.	**10**
4.	(a)	Discuss a) Solar PV Micro inverter b) Distributed MPPT.	**10**
	(b)	What are the different ways to use solar thermal energy? Describe any one of them in brief with the help of a neat diagram.	**10**
5.	(a)	Illustrate the importance of energy storage systems in stand-alone PV systems. Specify C-rating and DoD of batteries.	**10**
	(b)	Explain geothermal power plant with its advantages and disadvantages.	**10**
6.	(a)	Explain the principles of the following technologies i) Tidal energy ii) wave energy.	**10**
	(b)	Discuss the power conversion topology of fuel cell conversion system to feed ac loads.	**10**

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