3 Hours **Max. Marks:80**

NB:
Question 1 is compulsory
Attempt any three from question No.2 to Question No.6
Assumptions made should be clearly stated

Number to the right side indicate Marks

Q1 – Answer any four Questions.

a. List the needs and advantages of modelling electrical machines. (5)
b. Derive the output power equation of synchronous generator. (5)
c. Explain the needs for parallel operation of alternators. (5)
d. Explain hunting in synchronous motors. (5)
e. Explain measurement of Xd and Xq by slip test. (5)
f. Derive equation for pitch factor (Kp). (5)

Q2 (a)Explain armature reaction in synchronous alternator for different power factor loads. 10

(b) Calculate the RMS value of the induced EMF per phase of a 10 pole 3 phase 50 Hz alternator with 2 slots per pole per phase and 4 conductors per slot in two layers coil span is 150 degree the flux per pole is 0. 12 Wb. 10

Q3 (a)Define regulation and hence explain Zero Power Factor (ZPF) used to calculate regulation. 10

(b)3 phase star connected 1000 kVA, 2000 V, 50 Hz, star connected alternator, gave following test results,

Field current (A)	10	20	25	30	40	50
OC voltage (V)	800	1500	1760	2000	2350	2600
ZPF voltage (V)	-	200	250	300	-	0

Armature effective resistance per phase is 0.2 Ω. Draw characteristic curves and find the regulation at 0.8 power factor lagging and leading by MMF method. 10

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Q4 (a) What is the need for parallel operation? Explain the effect of changing mechanical torque (prime mover input) on parallel operation of two alternators connected in parallel. 10

(b)Two station generators A and B operate in parallel. Station capacity of A is 50 MW and of B is 25 MW. Full load speed regulation of station A is 50 MW and of B is 25 MW. Full load speed regulation of station A is 3 % and B is 3.5 %. Calculate the load sharing if connected load is 50 MW, no load frequency is 50 Hz. 10

Q5 (a)Explain Blondel's two reaction theory in detail. 10

(b) 3300 kVA, 3 phase star connected, 6600 V, 8 pole, 50 Hz cylindrical alternator has synchronous reactance of 20% and it is running parallel with infinite bus. Calculate synchronizing power and corresponding synchronizing torque per mechanical degree of phase displacement at

1. No load 2. Full load 0.8 power factor (lagging). 10

Q6.(a)With necessary phasor diagrams explain V and Inverted-V curves of synchronous motor. 10

(b)3 phase, 40 kW, 400 V, 50 Hz, Star connected synchronous motor has full load efficiency of 90%. The synchronous impedance of the motor is 0.25+ j12 per phase. If the excitation of the motor is adjusted to give leading power factor of 0.8. Calculate the induced emf and total mechanical power developed at full load. 10

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Duration – 3 Hours **Total Marks - 80**

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

Q 1. Answer all questions.

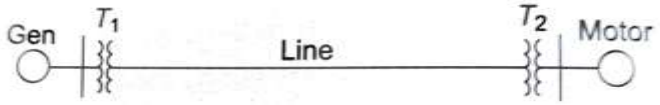
A) State different types of Faults takes place in electrical power system and explain each in 2 sentences **05**

B) Define with reference to Insulation coordination: 1. BIL 2. FOW **05**

C) Discuss the role of bundle conductors in corona. **05**

D) Why ground wires are provided on top of the Transmission lines? **05**

Q 2 a) A synchronous generator and synchronous motor each rated at 25 MVA and 11KV having 15 % sub transient reactance are connected through transformer and line as shown. The transformer is rated for 25 MVA 11/66 KV and 66/11 KV with leakage reactance of 10%. The line has reactance of 10% on the base of 25 MVA and 66 KV. The motor is drawing 15 MW at 0.8 pf leading and terminal voltage is 10.6KV .when symmetrical three phase fault occurs at the terminal of motor. Find the sub transient current in generator, motor and fault. **10**



Q 2 b) Derive Fortescue theorem for Symmetrical fault analysis **10**

Q 3 a) Find Critical disruptive voltage and Critical voltage for local and general corona on three phase overhead transmission line consisting of three stranded copper conductors spaced 2.5m apart at the corners of an equilateral triangle. Air temperature and pressure are 21 Degree centigrade and 73.6 cm of mercury respectively. The conductor diameter is 10.4mm. Surface factor is 0.85. Surface irregularity factors for local and general corona are 0.7 and 0.8 respectively. **10**

Q 3 b) Derive the mathematical equation of flux linkage due to radio interference in neighbourhood communication lines due to corona **10**

Q 4 a) Discuss the operation of synchronous machine on loaded condition with waveform equation and equivalent circuit diagram. **10**

Q 4 b) Derive the equation for fault current for Single Line to Ground Fault. State the various assumptions. Draw the sequence network for same **10**

Q 5 a) Why Insulation Coordination is required? Explain the following: 1. Surge Reactor 2. Surge Capacitor 3. Lightning Rod **10**

Q 5 b) Explain construction and working of following: 1. Thyrite type Surge Arrester 2. Metal Oxide Gapless Arrester **10**

Q 6 a) A delta connected balanced resistive load is connected across an unbalanced three phase supply. where the current in line A is 10A at angle (30 degree) and current in line B is 15A at angle (-60degree). Find the symmetrical components of line currents also find the symmetrical components of delta currents. **10**

Q 6 b) Discuss the formation of Corona. State factors affecting the corona. **10**

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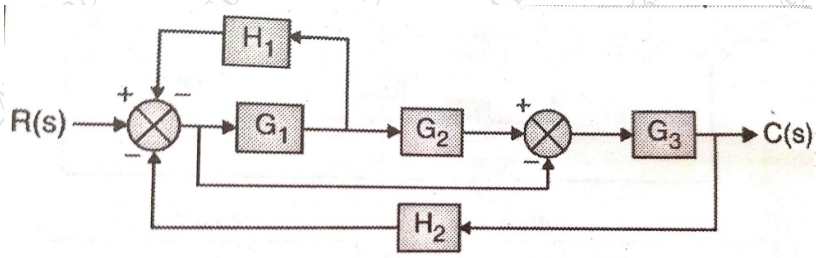
Time (3 Hours) **80 Marks**

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

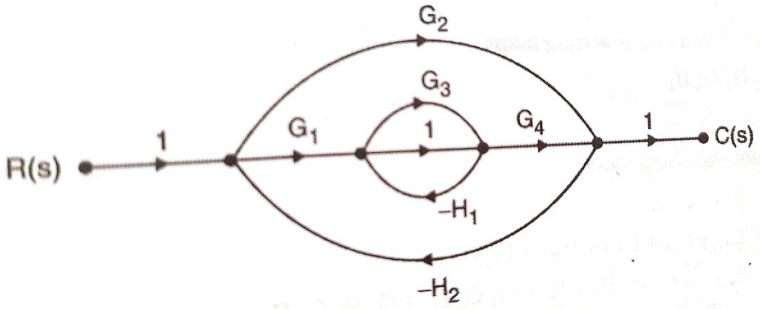
Q 1.Attempt any Four 20Marks

a. Explain the effects of addition of open loop poles and zeros on root locus and transient response.
b. Differentiate between open loop and closed loop system.
c. What ate the advantages of using state space analysis over classical approach?
d. Explain Nyquist Criterion for stability.
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. 10 Marks



b. Obtain the transfer function for the following figure using Mason's gain formula 10 Marks



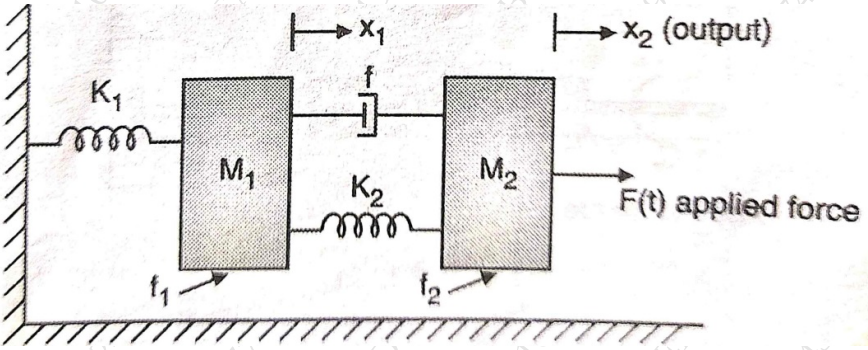
Q3. a. Given the unity feedback system that has the forward transfer function 10 Marks
G(s) = $\frac{k(s+2)}{s\,(s^2+4s+13)}$.Sketch the complete root locus.

b. For a system with characteristic equation: 10 Marks
F(s)=$s^4 + 2s^3 + 10s^2 + s + K = 0$,obtain the value of k for marginal stability and also find the frequency of oscillation at that value of k using Routh Hurwitz criteria.

Q4.a. A feedback control system has G(s) H(s) = $\frac{100}{s\,(s+0.5)\,(s+10)}$. Draw Bode plot And comment on stability. 10 Marks

b. For a unity feed back system has a forward path transfer function G(s)=(S+2)/S(S+1) Determine rise time, peak time, peak overshoot, settling time, delay time to unit step input 10 Marks

Q5. a. Find the transfer function X(s) / F(s) of the following system using mathematical modeling of the system. 10 Marks



B .Represent the following state space equation in phase variable form 10 Marks

and also draw its state model $\frac{C(s)}{R(s)} = \frac{10\,(s+2)(s+3)}{(s+1)(s+4)(s+5)}$

Q 6 a.The control system having unity feedback has G(s) = = $\frac{20(s+3)}{(1+s)\,(6+s)}$. 10 Marks

Determine (1)Type of system. (2) All error coefficient (3) error when subjected tostep of magnitude 2.

b. Explain AC servomotor and also draw the diagram. 10 Marks

Q. P. Code:

(Time: 3 Hours) **[Maximum Marks: 80]**

N.B.: 1. Q. 1 is compulsory
2. Answer any three out of remaining five questions
3. Assumptions made should be clearly stated.
4. Assume any suitable data wherever required but justify the same

Q. 1 Solve **ANY FOUR** questions from following. (Each question carries 5 marks)

a) Point charge Q= 5 μC placed at origin, find electric potential at (0,4,3)m . **(05)**

b) Explain Lorentz's force equation for either moving charge or the current carrying element. Enlist two applications of Lorentz's force in electrical measurements. **(05)**

c) Convert the following points specified in cylindrical into spherical co-ordinates **(05)**
(i) (2,5π/3, -2)
(ii) (4, π/6,1)

d) Define gradient of a scalar quantity. Derive the relation between $\overline{E}$ and the electric potential V. **(05)**

e) Derive point and integral forms of Ampere's circuital law. **(05)**

Q. 2 a) Derive electric field intensity due to an infinite line with line charge density of ρ_l (C/m) and infinite plane having surface charge density $\rho_s \left(C/m^2\right)$. **(10)**

Q. 2 b) A charge of $Q_1 = 3X10^{-4}C$ at A(1,2,3)m and a charge of $Q_2 = -10^{-4}C$ at B(2,0,5)m in a vacuum. Find following forces exerted on **(10)**
i) charge Q_2 by charge Q_1
ii) charge Q_1 by charge Q_2.
Infer the relation between above two forces.

Q. 3 a) Evaluate the charge enclosed and flux emitted by the closed surface using Gauss Divergence theorem for the electrostatic field with surface flux density $\overline{D}$ =2xy$\overline{a}_x$ +x^2 $\overline{a}_y$ C/m^2.The rectangular parallelopiped is formed by the planes x=0 and 1m,y=0 and 2m,z=0and 3m. **(10)**

Q. 3 b) For a vector field show that the divergence of the curl of any vector field is zero. **(10)**

Q. 4 a) Given the magnetic vector potential $\overline{A}$ = -ρ^2/4 $\overline{a}_z$ Wb/m. Calculate flux density and the total flux crossing the surface ϕ=π/2,1≤ρ≤2m,0≤z≤5m. **(10)**

Q. 4 b) Derive the Poisson's and Laplace equation. Formulate the capacitance of a parallel plate capacitor with air as a dielectric medium, d is the separation between plates with A as area of plates. **(10)**

Q. 5 a) Calculate the magnetic field intensity $\overline{H}$ due to infinite conductor carrying current I along z axis. **(10)**

Q. 5 b) A dipole with dipole moment -5 $\overline{a}_z$ nC/m is located at point(0,0,-2)m.Find the potential at origin. **(10)**

Q. 6 a) Derive Maxwell's equations in time domain and frequency domain. **(10)**

Q. 6 b) Formulate wave equation for perfectly dielectric medium. **(10)**

(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)	Compare Horizontal Axis Wind Technology and Vertical Axis Wind Technology.	20
	(b)	List out the solar PV technologies. Illustrate anyone in brief.	
	(c)	Write a short note on Solar Pond.	
	(d)	Explain the role of renewable energy and energy storage systems in a futuristic power system scenario. Describe the renewable energy policy adopted by India.	
2.	(a)	Explain the working principle of geothermal energy conversion. Write its advantages and disadvantages.	10
	(b)	Explain the working of WES with its various components. What are the different power converter topologies used for WES? Explain any one of them in detail.	10
3.	(a)	Illustrate the significance of MPPT in PV system. Distinguish between mechanical and electrical means of MPPT. Explain perturb and observe MPPT algorithm with the help of suitable diagram.	10
	(b)	Draw I-V and P-V characteristics of solar PV panels at standard test conditions. Clearly mark all essential parameters on the characteristics. Also show the impact of change in solar radiation and operating temperature on its characteristics.	10
4.	(a)	Explain the types of wind turbine and Wind turbine characteristics	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)	State the effect of the following on solar PV system performance i) Mismatch in modules ii) Hot spots in the modules iii) Bypass diode iv) Blocking diode.	10
	(b)	Describe the working principle of proton exchange membrane fuel cell (PEMFC) and explain its electrical characteristics. Draw a PEMFC fed power converter topology that can be used to feed a single-phase standalone load.	10
6.	(a)	Explain the principles of the following technologies i)Tidal energy ii) wave energy	10
	(b)	Describe the electrical power generation with the following technology in brief: Ocean thermal energy system	10

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