Duration:- Three Hours **Total Marks Assigned:- 80**

NOTE

1. Question No 1 is Compulsory.
2. Solve any three out of the remaining.
3. Figure to the right side indicates marks.
4. Assume the suitable data and mention the same if required

Q No 1 Answer the following

a. Why are the pre fault currents usually neglected in fault computation? [5]

b. Why the HV lines are provided with ground wire as a topmost conductor? [5]

c. Which type of fault/faults occurs frequently? And Why? [5]

d. Why insulation coordination is required? [5]

Q No 2a Derive the Fortesque Theorem for symmetrical component analysis [10]

Q No 2b A 25 MVA 13.2 KV alternator with solidly grounded neutral has sub transient reactance of 0.25pu. The negative and zero sequence reluctances 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 No 3a Derive the equation for Fault current for a double line to ground fault. State the various assumptions. Draw the sequence network for same. [10]

Q No 3b In a Four bus system (1,2,3,4) Buses are connected to each other by 1Ω element as 1-2;2-4;4-3; 3-3 and 1-4. Taking Bus 4 as reference Obtain [$\mathbf{Z}_{\mathbf{Bus}}$] [10]

Q No 4a Discuss the phenomenon of transient generation due to capacitance switching. [10]

Q No 4b Discuss the terms with respect to lightning phenomenon **"Insulator Flashover, Withstand Voltage; Direct Stroke".** [10]

Q No 5a A surge of 15 KV is traveling along the cable towards the junction with an overhead line. the inductance and capacitance of cable and overhead line are respectively 0.3 mH, 0.4uF and 1.5mH ,0.012 uF per km. Find the voltage rise at the junction due to surge. [10]

Q No 5b Write an algorithm for short circuit studies. [10]

Q No 6a Find critical disruptive voltage, and critical voltage for local and general corona on three phase over head transmission line consisting of three stranded copper conductors spaced 2.5 m apart at the corners of an equilateral triangle. Air temperature and pressure are 21degree centigrade and 73.6 cm of mercury respectively. The conductor diameter, surface irregularity factor and surface factors are 10.4mm,0.85, 0.7 and 0.8 respectively. [10]

Q No 6b Discuss the sequence networks of Synchronous Machine [10]

(Time: 3Hours) MAX MARKS 80

NOTE

1.Question number 1 is compulsory
2.Attempt any three from the remaining
3.Figures to right indicates full marks
4.Assume suitable data if necessary and mention the same

1.		Attempt any four of the following :-	20
	a)	What is the objective of performing no load and blocked rotor test on 3 phase induction motor?	05
	b)	Explain capacitor start 1-phase single phase Induction motor.	05
	c)	Explain dispersion coefficient.	05
	d)	What is the significance of magnetic loading?	05
	e)	Why do we need to apply reduced voltage at the time of starting of 3- phase Induction motor?	05
2.			20
	a)	Explain the effect of frequency and voltage variation on Induction Motor performance.	10
	b)	A 3 phase, 6 poles, star connected, Induction motor connected to 415V, 50 Hz supply has the rotor resistance and standstill reactance are 0.12 and 0.85 ohms per phase. The stator to rotor turns ratio is 1.8 and full load slip is 4%. Calculate the full load torque, maximum torque and the speed at maximum torque.	10
3.			20
	a)	Derive the output equation of a 3-phase Induction motor in terms of main dimensions.	10
	b)	Discuss the concept of Carter's coefficient in detail	10
4.			20
	a)	What is frame and frame size in case of Induction motor? Draw a figure showing structural dimensions of standard frame?	10
	b)	Determine the main dimension, turns per phase, no. of slots, conductor cross section and area of slot for a 3-phase, 50Hz, 4 pole, 250HP, 400V,1410rpm, delta connected squirrel cage induction motor with the data given: average flux density in air gap = 0.5Wb/m^2, ampere conductor per meter = 30,000A/m, efficiency =90%, pf = 0.9, winding factor = 0.955, current density = 3.5 A/mm^2 , slot space factor = 0.4, ratio of length of core to pole pitch = 1.2.Assume 5 slots per pole per phase. Assume three phase fault	10

5. 20

a) Derive Equivalent circuit diagram of 3–Φ induction motor. 10

b) A 15kW,440V , 4pole 50Hz, 3–Φ, star connected induction motor gave following test results : 10

	Line Voltage	Line current	Power input
No load Test	440V	10A	1310W
Blocked rotor test	200V	50A	7100W

Assume stator and rotor ohmic losses equal at standstill. Draw the circle diagram.

6. Write short notes on (any two) 20

a) Double field revolving theory 10

b) Cogging and crawling in 3 –Φ induction motor. 10

c) Reluctance starting in 1- phase Induction motor. 10

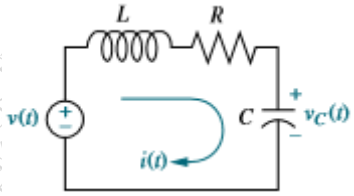
Time: (3 Hours) **Total Marks – 80**

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 any FOUR of the following** 20

a. Sketch the polar plot of the transfer function $G(s) = \frac{1}{s^2}$

b. Find the transfer function relating the capacitor voltage, $V_c(s)$, to the input voltage, V(s) in the following figure

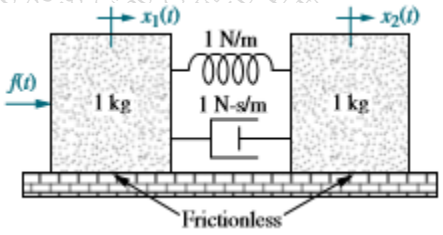


c. Represent the given system in cascade form of state space representation. Also draw SFG.

$$G(s) = \frac{5}{(s+3)(s+9)(s+7)}$$

d. Compare open loop and closed loop control systems with the help of suitable example.

e. Find the transfer function, $G(s) = \frac{X_2(s)}{F(s)}$, for the translational mechanical network shown



Q.2 a. Given the system represented in state space as follows: 10

$$\dot{x} = \begin{bmatrix} 0 & 1 & -2 \\ 0 & 3 & 1 \\ -5 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix} u$$

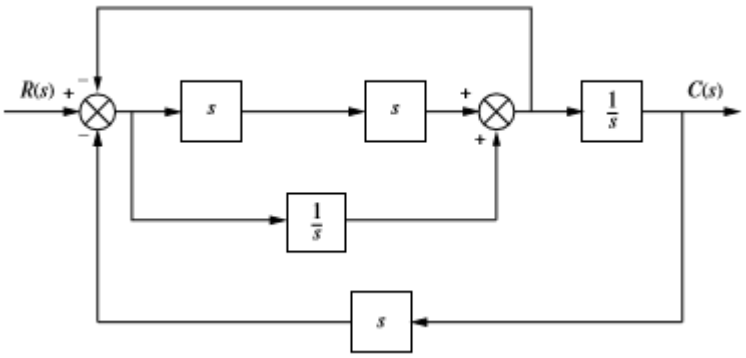
$$y = [1 \quad 3 \quad 2]x$$

Convert the system to one where the new state vector, z is

$$z = \begin{bmatrix} 1 & 3 & -2 \\ 4 & -1 & 0 \\ 2 & 5 & 1 \end{bmatrix} x$$

b. Derive the formula for rise time, peak time, settling time and percentage overshoot for a second order system. 10

Q.3 a. Covert given block diagram into signal flow graph and obtain transfer function $G(s) = \frac{C(s)}{R(s)}$ using Mason's rule. 10



b. Obtain Laplace transform solution of the following system. 10

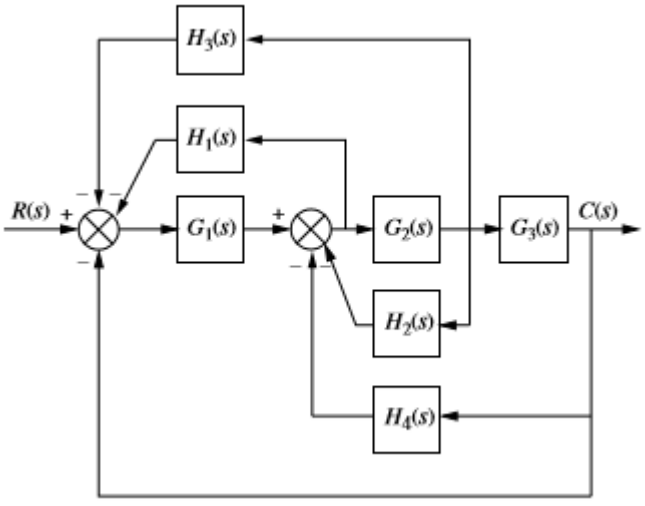
$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -24 & -26 & -9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} e^{-t}$$

$$y = [1 \quad 1 \quad 0]x$$

Q.4 a. Draw Bode plot for the following unity feedback system, determine ω_{gc}, ω_{pc},PM, GM and comment on the stability of the system. 10

$$\boldsymbol{G(s) = \frac{100(s+2)}{s(s+1)(s+4)}}$$

b. Reduce the block diagram shown below to a single block representing the transfer function, G(s) = C(s)/R(s) 10



Q.5 a. A unity feedback system has an open-loop transfer function 10

$$G(s) = \frac{K}{(s+2)(s+4)(s+6)}$$

Plot Nyquist diagram and using your diagram find the range of gain K for stability

b. The characteristics equation of a feedback control system is 10
$s^4 + 20s^3 + 15s^2 + 2s + K = 0$

a) Determine range of K for the system to be stable.

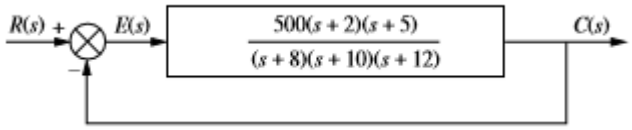
b) Can the system be marginally stable? If so, find the required value of K and the frequency of sustained oscillation.

Q.6 a. A unity feedback system has an open-loop transfer function 10

$$G(s) = \frac{K(s+3)}{s(s+1)(s+2)(s+4)}$$

Sketch the root locus

b. Evaluate the static error constants for the following system and find the expected error for the standard step, ramp, and parabolic inputs. 10



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

Note:- 1. Question No. 1 is compulsory
2. Attempt any **three** questions out of remaining **five** questions
3. Assume suitable data if necessary & justify the same

1	Attempt **any four**.	
(A)	With the help of two transistor analogy of SCR, briefly explain why gate loses its control once SCR is turned ON?	5
(B)	Mention any two applications of dc to dc converter. Draw the diagram of a Buck dc to dc converter and draw the inductor voltage, inductor current and derive the voltage ratio.	5
(C)	What are the advantages of PWM rectifier as compared to controlled rectifier using SCR? What are its applications? Illustrate the diagram of a single phase PWM rectifier.	5
(D)	Illustrate the diagram of a single-phase half bridge inverter and draw the output voltage waveform for square wave mode of operation. Such an inverter is connected to a resistive load of 2.4 Ω with d.c. input voltage of 24V each. Determine: (i) RMS output voltage (ii) Output power and (iii) Peak blocking voltage of each switch.	5
(E)	Compare Silicon Carbide and Gallium Nitride devices.	5
2 (A)	Explain any two commutation methods of SCR.	10
(B)	Describe any one application of Triac-Diac circuit. Derive the expression for RMS value of output voltage and draw the following waveforms: (i) Supply voltage; (ii) load voltage; (iii)Voltage across Triac.	10
3 (A)	Explain the operation of 3Φ bridge inverter feeding a resistive load for 180^0 conduction mode. Draw the pulse sequence for the switches & sketch all phase voltages and any one line to line voltage waveform.	10
(B)	What is the need for a Snubber circuit? Explain any one snubber circuit.	10
4 (A)	Draw the diagram of a Boost converter and derive its voltage ratio. In Boost converter, V_d=12V, R_L=24Ω, L=1mH, f_s=10kHz and the output voltage required is twice than that of input. Find (i) duty cycle; (ii) the peak to peak inductor current ripple and (iii)average input current. Assume lossless converter.	10
(B)	Give a comparison between MOSFET and IGBT (any five points). Why driver circuit is needed to drive MOSFET & IGBT? Suggest any suitable driver circuit.	10
5	Draw a three phase half controlled rectifier (semi controlled) and the gating pulse sequence and explain briefly. (i) Draw the input and output voltage waveforms for a firing angle of α=0° and α=30°. (ii) Derive the average output voltage in terms of α for a purely resistive load. (iii) Find the numerical value of output voltage and current for a firing angle of 30°, if this converter is fed from a 440V, 3Φ, 50Hz supply and is feeding a resistive load of 12 ohms. Graph sheet will be provided.	20
6(A)	With neat diagrams explain the operation of AC voltage controller feeding R-L load.	10
(B)	Explain any two pulse width modulation technique of inverter.	10

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

N.B: 1. Question no. 1 is compulsory.

2. Attempt any three questions out of remaining five questions.

Q1. Attempt all four: 20M

a) Compare narrow band and wide band FM systems.
b) Illustrate the operation of VSB transmission.
c) Draw the frequency spectrum of AM wave and explain.
d) Explain sampling theorem.

Q2. (a) Draw the block diagram of single side band AM transmitter and explain each block. 10M

(b) How does phase shift method efficiently suppress unwanted side band? Explain with diagram. 10M

Q.3 (a) Explain the generation of direct FM signals. What is the difference between direct and indirect FM. 10M

(b) What is Pre- emphasis and De-emphasis? Why is it used? 10M

Q.4 (a) What is demodulation? Explain balanced slope detector method of FM demodulation with the help of neat diagram. 10M

(b) Draw the block diagram of the following and explain TRF Receiver and Super heterodyne Receiver . 10M

Q.5 (a) Explain the terms PAM, PWM, PPM. Explain the principle of delta modulation. 10M

(b) Explain different sampling techniques. Explain aliasing error and aperture effect. 10M

Q.6 Write in brief any two 20M

(a) Varactor diode modulator
(b) Foster Seeley discriminator.
(c) Pulse Communication.

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(3Hrs) **Total Marks: 80**

N.B.

1. **Question No.1 is Compulsory.**
2. Answer any three out of remaining five questions
3. Assume any suitable data wherever necessary and justify the same
4. Illustrate answer with sketches wherever required

Q 1	a	Illustrate the term distributed generation. What are the issues towards integrating DG with the grid?	**5**
	b	What is the C-rating of battery? A battery is rated as 100 Ah at 5C. Will the available capacity be different if it is discharged at 1C? Explain.	**5**
	c	What are the different ways to use solar thermal energy? Describe any one of them in brief with the help of neat diagram.	**5**
	d	Illustrate the advantages and disadvantages of a horizontal axis wind turbine (HAWT).	**5**
Q 2	a	What are types of fuel cell? Explain in detail fuel cell which can be molded in different shapes	**10**
	b	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**
Q 3	a	Explain the principles of the following technologies: i) Tidal energy ii) Biomass based power generation	**10**
	b	Illustrate the financial benefits of energy storage systems in detail.	**10**
Q 4	a	Draw I-V (current v/s voltage) characteristics of a 315Wp solar PV panel with V_{mp} = 36V and I_{mp} = 8.75A at i) 1000 W/m^2 ii) 600 W/m^2. Clearly mark all essential parameters on characteristics. Also calculate peak power at 400 W/m^2.	**7**
	b	Draw neatly equivalent circuit of solar PV cell. Also list out the terms used in the equivalent circuit of solar cell.	**3**
	c	Draw the power topology of wind energy system (WES) based on Doubly Fed Induction Generator (DFIG) and SCIG. Also compare their advantages and disadvantages.	**10**
Q 5	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	Illustrate the term Power Coefficient, Tip Speed ratio of a wind turbine	**05**
	c	What are the advantages and disadvantages of Fuel cell-based power generation in comparison with solar PV based power generation	**05**

Q 6 Write a short note on **any four** **20**

a) Pumped hydro energy storage system
b) Distributed MPPT
c) Comparison of mono-crystalline and poly-crystalline solar cell
d) Flywheel as an energy storage device
e) Application of ultra-capacitor and battery in electric vehicle

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(Three Hours) **(80 Marks)**

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. Answer the following questions. **20**
a) What are various types of electric braking used?
b) What is Specific energy consumption and list the factors that affecting it.
c) What are the causes of low power factor?
d) What are the requirements of ideal traction?

Q 2 a) Explain methods of power factor improvement. **10**

Q 2 b) An electric train is to have acceleration and braking retardation of 0.8 km/h/s and 3.2 km/h/s respectively. If the ratio of maximum to average speed is 1.3 and time for stops 26 seconds, find schedule speed for a run of 1.5 km. Assume simplified trapezoidal speed-time curve. **10**

Q 3 a) Give classification of electric welding and explain Butt welding and Spot welding. **10**

Q 3 b) Derive an expression for trapezoidal speed time curve. **10**

Q 4 a) What are the different types of track electrification? **10**

Q 4 b) Explain traction SCADA. **10**

Q 5 a) Explain the working of Ajax Wyatt vertical core furnace with a neat sketch. **10**

Q 5 b) Derive an expression for tractive efforts produced at driving axle. Explain the terms dead weight, accelerating weight and adhesive weight. **10**

Q 6 a) Draw and explain the vapor compression and vapor absorption type refrigeration cycle with their application. **10**

Q 6 b) What are the requirements for traction motor control? Explain open circuit transition and shunt transition in series parallel control method. **10**
