**Duration:- Three Hours** **Total Marks : 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 questions

a. Discuss the role of bundle conductors in corona. [5]

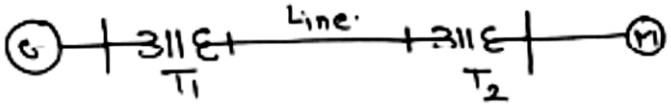
b. Explain the terms with respect to insulation level; BIL,FOW [5]

c. Discuss the role of Z bus system in short circuit study [5]

d. What are the various assumption in development of sequence network of transformer. [5]

QNO 2a Derive an equation for maximum value of short circuit current on a transmission line. State the various assumptions made. [10]

QNO 2b 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]




QNO 3a Discuss the Fortesque theorem for symmetrical component analysis [10]

QNO 3b 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]

QNO 4a Derive the sequence network for one conductor and two conductor open condition from circuit conditions and symmetrical components. [10]

QNO 4b Discuss the operation of synchronous machine on loaded condition with waveform equation and equivalent circuit. [10]

QNO 5a Derive the equation for fault current and sequence network for an line to line ground fault. State the various assumptions in calculation. [10]

QNO 5b Discuss the generation of voltage and current travelling waves on a short circuited line with figure and equations. [10]

QNO 6a Calculate the voltage and current rating of an arrestor if it is placed at the end of line and at the junction of two, lines. Draw the equivalent circuit for the same. [10]

QNO 6b Discuss the generation and formation of corona ring and corona pulses in EHV lines. [10]

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

Note: 1. Question No. **1** is **Compulsory**
2. Solve any **3** questions out of remaining questions
3. Assume suitable data if necessary.

Q. 1 Attempt **any four** of the following:
a) What is the significance of $B_{60}$ in Induction machine design? (5)
b) Enlist the types of 1-Φ Induction motors and their applications. (5)
c) Why 1-Φ induction motor is not self starting? Draw its torque –slip characteristics. (5)
d) Why the induction motor is called as a poor power factor machine? Also explain why it is called as a generalised transformer? (5)
e) What do you mean by electric loading? (5)

Q. 2 a) Derive the output equation of 3 phase Induction motor in terms of main dimensions. (10)
b) What is frame and frame size in case of Induction motor? Draw a figure showing structural dimensions of standard frame? (10)

Q. 3 a) Explain the torque speed characteristics of 3 phase induction motor in braking, motoring and generating regions. (10)
b) Discuss the effects of dispersion coefficient on maximum power factor and on overload capacity of 3 ph Induction motor. (10)

Q. 4 a) Is it possible to change the direction of rotation in shaded pole type induction motor? Justify. (10)

b) Determine the main dimensions, turns per phase, number of slots of a 250 Hp, 3ph, 50Hz, 400V, 1410rpm, slip ring induction motor. Assume $B_{av}$ = 0.5 Wb/ $m^2$, ac = 30000 A/m, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5 A/$mm^2$. The slot space factor is 0.4 and the ration of core length to pole pitch is 1.2. The machine is delta connected. (10)

Q. 5 a) Explain Double field revolving theory. (10)
b) Explain the effect of voltage and frequency variations on Induction motor performance. (10)

Q. 6 Write short note on **(any TWO)** (20)
i) Methods of starting of 3 –Φ Induction motor
ii) Explain cogging and crawling in 3–Φ Induction motor
iii) Calculation of leakage reactance of parallel sided slots

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

1. Question no. 1 is **compulsory**.
2. Answer any **three** from remaining.
3. Figures to the **right** indicate **full marks.**

Q. 1 **Answer any FOUR of the following** 20

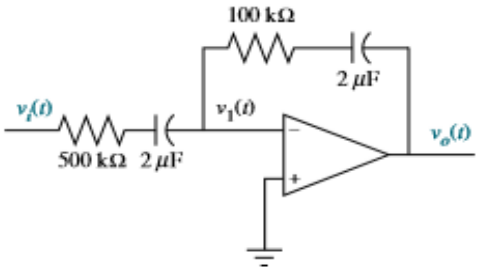
a. A system is defined by

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix} u$$

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

Find the transfer function, *T(s) = Y(s)/U(s)* where *U(s)* is the input and *Y(s)* is the output.

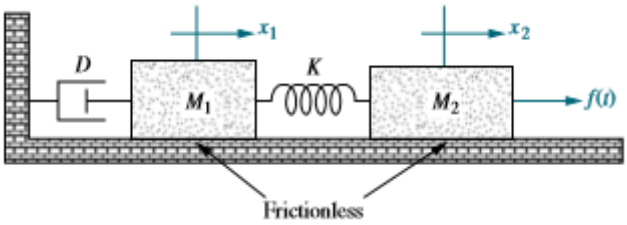
b. Find the transfer function relating the output voltage $V_o(s)$, to the input voltage, $V_i(s)$ in the following figure




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

d. Compare open loop and closed loop control systems.

e. Find the state equations for the translational mechanical system shown below




Q.2 a. Represent the given system in cascade, parallel and phase variable form of state space representation. Also draw SFG. 10

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

b. A unity feedback system has the following forward transfer function:

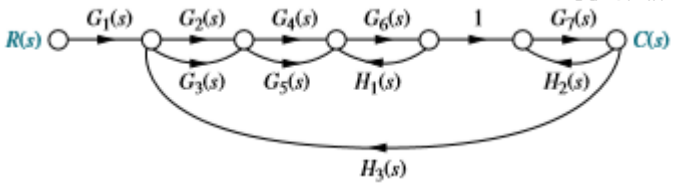
$$G(s) = \frac{1000(s+8)}{(s+7)(s+9)}$$

(i) Evaluate system type, $K_p$, $K_v$, and $K_a$.

(ii) Use your answers of (i) to find the steady-state errors for the standard step, ramp, and parabolic inputs.

10

Q.3 a. Obtain transfer function $G(s) = \frac{C(s)}{R(s)}$ using Mason's rule. 10

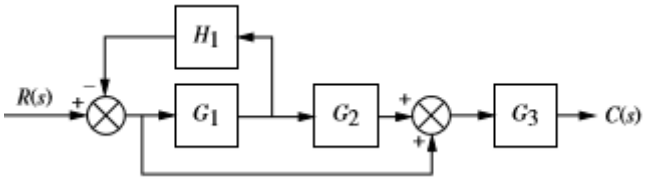



b. Derive the formula for Laplace transform solution using state space. 10

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

$$\boldsymbol{G(s) = \frac{(s+3)}{(s+2)(s^2+2s+25)}}$$

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. Derive and explain Nyquist stability criteria. 10

b. A unity feedback system has an open-loop transfer function

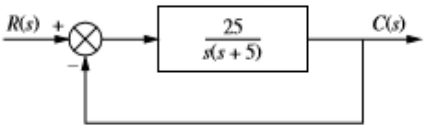
$$G(s) = \frac{K(s-2)(s-4)}{(s^2+6s+25)}$$

Sketch the root locus

Q.6 a. The characteristics equation of a feedback control system is 10
$s^4 + 2s^3 + 15s^2 + 2s + K = 0$

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.

b. For the system shown in below, find the peak time, percent overshoot, and settling time. 10

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**Duration:3hrs** **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**. | |
| (i) | Compare single phase half bridge and full bridge inverter | 5 |
| (ii) | Explain briefly the need of driver circuits for MOSFET/IGBT. | 5 |
| (iii) | Illustrate the protection circuit of SCR. How do you protect an SCR from overcurrent and overvoltage? | 5 |
| (iv) | Illustrate the circuit diagram of a single phase PWM rectifier and mention its advantages. | 5 |
| (v) | Compare Silicon Carbide and Gallium Nitride devices. | 5 |
| 2 (A) | With the help of two transistor analogy, describe the principle of operation of SCR. | 10 |
| (B) | Explain any one type of single phase cyclo converter. | 10 |
| 3 (A) | With a neat diagram of 3Φ bridge inverter feeding a star connected resistive load, explain the operation for $120^0$ conduction mode. Sketch all phase voltages. | 10 |
| (B) | Explain conduction and switching losses in a semiconductor device. | 10 |
| 4 | Draw a three phase fully controlled rectifier (full converter) connected to a resistive load, the gating pulse sequence and explain briefly. (i) Draw the input and output voltage waveforms for a firing angle of α=60°. (ii) Derive the average output voltage in terms of α for a purely resistive load. | 20 |
| 5 (A) | Explain Sinusoidal Pulse width modulation (SPWM) technique. What is the main advantage of Space Vector Modulation (SVM) as compared to SPWM? | 10 |
| (B) | Compare power BJT and IGBT | 10 |
| 6(A) | Illustrate the diagram and the output voltage waveforms of a controlled rectifier suitable for four quadrant operation. What are its applications? | 10 |
| (B) | Illustrate the diagram of Buck dc to dc converter and derive the voltage ratio. Buck converter has an input voltage of $V_d$= 14V.The required average output voltage is $V_o$=6V, $R_L$= 200Ω and peak to peak ripple voltage is 20mV.The switching frequency is 25kHz. If the peak to peak ripple current in inductor is limited to 0.8A, determine(i) duty cycle of switch and (ii) value of inductor. | 10 |

**Duration – 3 Hours** **Total Marks - 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.** Answer the following questions. **20**

a) Draw typical speed time curve of a train running on main line and explain five distinct periods.

b) Write short note on different accessories for track electrification.

c) What are the methods of power factor improvement?

d) Explain the suitability of DC series motor for traction.

**Q 2 a)** What are the different types of track electrification? **10**

**Q 2 b)** Derive expression for most economical power factor improvement with usual notations. **10**

**Q 3 a)** Analyze the Quadrilateral speed time characteristics and derive an expression for the distance in terms of $V_1, V_2, \alpha, \beta$ **10**

**Q 3 b)** Draw and Explain the speed control method of DC Motors. **10**

**Q 4 a)** A 100-ton weight train has a rotational inertia of 10%. This train has to be run between two stations that are 3 km a part and has an average speed of 50 km/hr. The acceleration and the retardation during braking are 2 kmphps and 3kmphps, respectively. The percentage gradient between these two stations is 1% and the train is to move up the incline the track resistance is 50 N/ton, then determine: **10**

1. Maximum power at the driving axle.
2. Total energy consumption.
3. Specific energy consumption.

The combined efficiency of the alembic train is 70%. Assume simplified trapezoidal speed–time curve

**Q 4 b)** State necessity of railway signaling & Explain traction SCADA. **10**

**Q 5 a)** What are the terminologies used for refrigeration? Describe vapour absorption system in detail. **10**

**Q 5 b)** What is feeding post and feeding & sectioning arrangement in traction system? **10**

**Q 6 a)** With a neat diagram explain Vertical Core type induction furnace and state advantages of it. **10**

**Q 6 b)** Draw a neat diagram of spot welding machine and explain its working & Give application of resistance welding **10**

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