B.L.D.E.A's V.P.Dr.P.G.HALAKATTI COLLEGE OF ENGINERING AND TECHNOLOGY VIJYAPUR 586103

QUESTION PAPERS June - July 2024

ELECTRICAL AND ELECTRONICS DEPARTMENT

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18-VII sem. EE

CBCS SCHEME

USN | | | | | | | | | | |

18EE71

Seventh Semester B.E. Degree Examination, June/July 2024
Power System Analysis – II

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define (i) Graph (ii) Tree (iii) Loop, with an example. **(06 Marks)**

b. For the sample power system shown in Fig.Q1(b), obtain $\hat{A}$, A, K, B, $\hat{B}$, C and $\hat{C}$. Take link elements as 4 and 5 and bus 1 as reference. Verify $A_\ell k^t = B_\ell$; $C_b = -B_\ell^t$.

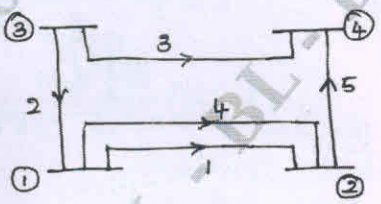

Fig.Q1(b) **(14 Marks)**

OR

2 a. Prove that $Y_{BUS} = A^t [y] A$ with usual notations. **(08 Marks)**

b. Obtain Y_{BUS} using singular transformation method for the system shown in Fig.Q2(b). Verify the obtained Y_{BUS} by inspection method.

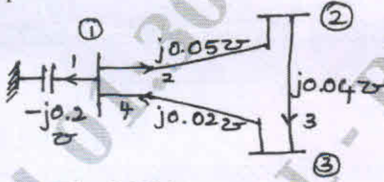

Fig.Q2(b) **(12 Marks)**

Module-2

3 a. Write a note on :
(i) Load Flow Analysis (ii) Classification of Buses **(10 Marks)**

b. Consider a three-bus system. The specifications at various buses are given in the table. Each line impedances $Z_L = j0.25$ pu. Neglect shunt admittances of all lines.

Busi	Type	$\|V_i\|$ pu	S_i	Injected Powers	
				P_i	Q_i
1	Slack	1	0	-	-
2	PQ	?	?	-0.5	-0.4
3	PV	0.9	?	0.5	-

Find V_2, S_2 and S_3 at the end of first iteration using Gauss-Siedel method. **(10 Marks)**

OR

4 a. Write the importance of acceleration factor during analysis. **(04 Marks)**

b. Briefly discuss on operating constraints. **(04 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

c. For the sample system shown, the data is shown in the Fig.Q4(c). All the buses other than the slack are PQ type. Assuming a flat voltage start, find the voltages and bus angles at the 3 buses at the end of the first GS iteration. Line data in impedance form.

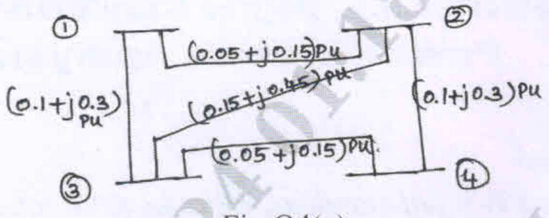

Fig.Q4(c) **(12 Marks)**

Module-3

5 a. Write a flow charts for the solution of the load flow by NR method. **(06 Marks)**

b. Obtain the voltages at all buses for the system shown in Fig.Q5(b) at the end of first iteration by NR method.

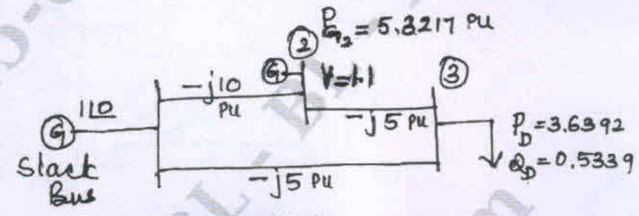

Fig.Q5(b)

The line data mentioned are in admittances. **(14 Marks)**

OR

6 a. Write an algorithm for the solution of load flow by FDLF method. Mention the assumptions made to get faster solution by FDLF. **(10 Marks)**

b. Compare Gauss-Siedel, Newton Raphson and Fast Decoupled Load Flow methods. **(10 Marks)**

Module-4

7 a. Deduce an expression for economic dispatch including transmission losses. **(06 Marks)**

b. Incremental fuel costs in rupees per MWh for a plant consisting of two units are,

$dC_1 \mid dP_{G1} = 0.2\, PG_1 + 40$

$dC_2 \mid dP_{G2} = 0.4\, PG_2 + 30$

and the generate limits are as follows:

$30 \text{ MW} \leq P_{G1} \leq 175 \text{ MW}$

$20 \text{ MW} \leq P_{G2} \leq 125 \text{ MW}$

Assume that both units are operating at all times. How will the load be shared between the two units as the system load varies over the full range of load values? What are the corresponding values of the plant incremental costs? **(10 Marks)**

c. Write a note on Input-Output curve and heat rate curve. **(04 Marks)**

OR

8 a. Derive an expression for transmission loss as a function of plant generation for a two plant system. **(08 Marks)**

b. Write a Dynamic Programming flowchart/algorithm for unit commitment problem. **(04 Marks)**

c. For the given sample system shown in Fig.Q8(c) the branch currents and impedances are ;

$I_a = 2 - j0.5$ pu ; $Z_a = 0.015 + j0.06$ pu
$I_b = 1.6 - j0.4$ pu ; $Z_b = 0.015 + j0.06$ pu
$I_c = 1 - j0.25$ pu ; $Z_c = 0.01 + j0.04$ pu
$I_d = 3.6 - j0.9$ pu ; $Z_d = 0.01 + j0.04$ pu

Calculate the loss formula co-efficients of the system in pu. The reference bus voltage is $1.0\angle 0^{\circ}$.

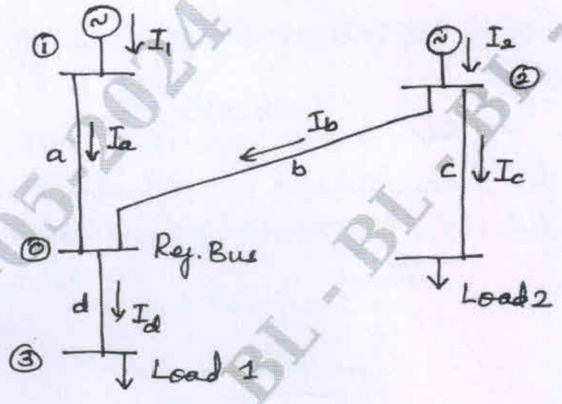

Fig.Q8(c)

(08 Marks)

Module-5

9 a. Derive the generalized algorithm for finding the elements of bus impedance matrix when a branch is added to the partial network. **(10 Marks)**

b. Form Z_{BUS} using building algorithm for the power system shown in Fig.Q9(b). Add the elements in the order specified on the figure. Self impedance of elements are marked on the figure and take bus-1 as reference bus.

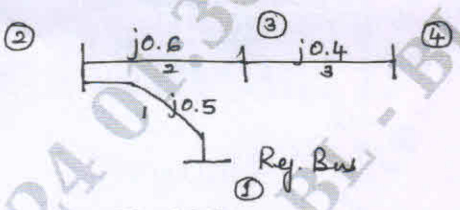

Fig.Q9(b)

(10 Marks)

OR

10 a. With the necessary equations, explain the solution of swing equation by point by point method along with graphical representation. **(10 Marks)**

b. Explain in detail the steps involved in numerical solution of swing equation by Range-Kutta method. **(10 Marks)**

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CBCS SCHEME

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18EE72

Seventh Semester B.E. Degree Examination, June/July 2024
Power System Protection

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With a neat diagram, explaining the zones of Protection in a Power System. **(06 Marks)**

b. List the advantages and disadvantages of Static relays. **(06 Marks)**

c. Derive an expression for torque produced by an induction relay. **(08 Marks)**

OR

2 a. List and explain the essential qualities of a protective relays. **(08 Marks)**

b. How Protective relays are classified? List them. **(06 Marks)**

c. Explain the classification of Protective schemes. **(06 Marks)**

Module-2

3 a. Draw and explain the circuit connections of three MHO units used at a particular location for three zones of protection. **(07 Marks)**

b. With neat connection diagrams, explain the working of directional earth fault relay. **(07 Marks)**

c. With neat diagram, explain Static impedance relay using amplitude comparator. **(06 Marks)**

OR

4 a. With a neat schematic diagram, explain the construction and working of reactance relay. **(06 Marks)**

b. Discuss the effect of power surges on the performance of different type of distance relay. **(08 Marks)**

c. Two relays R_1 & R_2 are connected in two sections of a feeds as shown in Fig, Q4(c). CT's are of ratio 1000/5A. The plug setting of relay R_1 is 100% and R_2 is 125%. The operating time characteristics of the relay is as given table.

P_{SM}	2	4	5	8	10	20
Operating time in seconds	10	5	4	3	2.8	2.4

The time multiplier setting of the relay R_1 is 0.3. The time grading scheme has discriminative time margin of 0.5s between the relays. A 3 – ϕ short circuit at F results in a fault current of 5000A. Find the actual operating times of R_1 and R_2. What is the time multiplier setting (TMS) of R_2. **(06 Marks)**

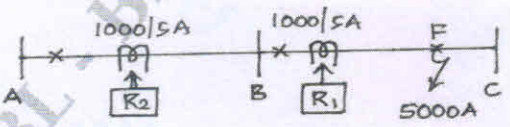

Fig. Q4(c)

Module-3

5 a. With neat diagram, explain harmonic restraint relay used to protect against magnetizing in rush current of transformer. **(08 Marks)**

b. Define the term 'Pilot' with reference to power line protection. List the different types of wire pilot protection schemes and explain any one of the schemes. **(08 Marks)**

c. With neat circuit diagram, explain rotor earth fault protection of alternator. **(04 Marks)**

OR

6 a. With a neat diagram, explain the working of Buccholz relay. **(06 Marks)**
b. With schematic diagram, explained (opposed) voltage differential protection. **(06 Marks)**
c. With a neat sketch, explain the working of frame leakage protection used for bus zone protection. **(08 Marks)**

Module-4

7 a. Explain the working of SF6 circuit breaker with the help of diagrams. Write two of its advantages. **(08 Marks)**
b. With a neat sketch, explain the recovery rate theory and energy balance theory of arc interruption in a circuit breaker. **(06 Marks)**
c. For a 132KV system, the reactance and capacitance upto the location of the circuit breaker is 3Ω and 0.015μF, respectively. Calculate the following :
i) The frequency transient oscillation.
ii) The maximum value of restriking voltage across the contacts of the circuit breaker.
iii) The maximum value of RRRV. **(06 Marks)**

OR

8 a. With neat circuit diagram, explain the synthetic testing of circuit breaker. **(06 Marks)**
b. With neat diagram, explain Air – break circuit breaker. Write any two its applications. **(06 Marks)**
c. Derive expressions for restriking voltage and RRRV on terms of System voltage, Inductance and Capacitance during fault on feeder. **(08 Marks)**

Module-5

9 a. Explain the modules / components of Gas Insulated Substations (GIS). **(06 Marks)**
b. With a neat sketch, explain the construction and working of Lichtenberg figures and Magnetic links. **(06 Marks)**
c. With a neat figure, explain the working of i) Rodgap arrestor ii) Expulsion type arrestor. **(08 Marks)**

OR

10 a. Describe the phenomenon of lighting and explain the terms pilot streamer, stepped leader, return streamer , dart leader , cold lighting stroke and hot lighting stroke. **(08 Marks)**
b. Describe the construction and operation of the HRC cartridge fuse with indicator. Write any four of advantages of HRC fuses. **(08 Marks)**
c. Write a short note on Arcing horn with diagram. **(04 Marks)**

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CBCS SCHEME

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18EE741

Seventh Semester B.E. Degree Examination, June/July 2024
Industrial Drives and Applications

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are the advantages of an electric drive? Mention the factor on which choice of an electric drive depends. **(06 Marks)**

b. With neat sketch, explain speed torque conventions and multi-quadrant operation of motor driving hoist load. **(08 Marks)**

c. A drive has following parameters:
$J = 10$ kg-m^2, $T = 100 - 0.1N$, N-m, Passive load torque $T_\ell = 0.05N$, N-m, where N is the speed in rpm. Initially the drive is operating in steady-state. Now it is to be reversed. For the motor characteristic is changed to $T = -100 - 0.1$ N, N-m. Calculate the time of reversal. **(06 Marks)**

OR

2 a. With neat sketches, derive the expression for the equivalent load torque and equivalent moment of inertia for loads with translational and rotational motion. **(07 Marks)**

b. A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a = 0.1 and efficiency of 90%. The load has a moment of inertia of 10 kg-m^2 and a torque of 10 N-m. Other load has translational motion and consists of 1000 kg weight to be lifted up at an uniform speed of 1.5 m/s. Coupling between this load and the motor has an efficiency of 85% motor has an inertia of 0.2 kg-m^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor. **(08 Marks)**

c. With a neat block diagram of an electrical drive, explain functions of each block. **(05 Marks)**

Module-2

3 a. Obtain the thermal model of motor for heating and cooling also draw the heating and cooling curve. **(08 Marks)**

b. Name the classes of motor duty. With neat graph, explain briefly. **(06 Marks)**

c. A constant speed drive has the following duty cycle:
(i) Load rising from 0 to 400 KW : 5 min
(ii) Uniform load of 500 KW : 5 min
(iii) Regenerative power of 400 KW returned to the supply : 4 min
(iv) Remain idle for : 2 min
Estimate power rating of the motor. Assume losses to be proportional to (power)^2. **(06 Marks)**

OR

4 a. With neat drive circuit and waveform, explain the single phase fully controlled rectifier control of separately excited dc motor. Also obtain equation for average output voltage V_a and speed W_m. Assume continuous conduction mode. **(08 Marks)**

b. A 200 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220 V, 50 Hz. Assuming continuous conduction, calculate:
(i) Firing angle for rated motor torque and 750 rpm
(ii) Firing angle for rated motor torque and (–500) rpm
(iii) Motor speed for $\alpha = 160°$ and rated torque. **(06 Marks)**

c. With neat drive circuit and waveform, explain the chopper control of separately excited dc motor for motoring control. Write its necessary equations. **(06 Marks)**

Module-3

5 a. Explain the behaviour of 3 phase induction motor with unbalanced source voltages and single phasing. **(06 Marks)**

b. Explain three phase induction motor operation with unbalanced rotor impedances. **(06 Marks)**

c. A 2.8 KW, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator: $R_S = 2\Omega$, $R'_r = 5\Omega$, $X_S = X'_r = 5\Omega$, $X_m = 80\Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage, calculate motor terminal voltage at 1200 rpm. **(08 Marks)**

OR

6 a. With a neat schematic diagram of star-delta starter, explain its working. **(07 Marks)**

b. Explain AC dynamic braking of 3 phase induction motor with: (i) Two lead (ii) Three lead connection. **(06 Marks)**

c. With Voltage-Frequency relation and speed-torque characteristics, explain variable frequency control of three phase induction motor and also list out its features. **(07 Marks)**

Module-4

7 a. Explain the operation of voltage source inverter fed induction motor drive also sketch various schemes of VSI fed induction motor drive. **(10 Marks)**

b. With neat sketch and waveform, explain current source inverter fed induction motor drive. **(10 Marks)**

OR

8 a. Explain the starting and pull in process in synchronous motor operation from fixed frequency supply. **(08 Marks)**

b. Explain the modes of variable frequency control of synchronous motor. **(06 Marks)**

c. With neat sketch, explain variable frequency control of multiple synchronous motors. **(06 Marks)**

Module-5

9 a. With neat circuit diagram, explain self controlled synchronous motor drive employing load commutated thyristor inverter. **(10 Marks)**

b. With neat sketch and waveform, explain brushless dc (trapezoidal PMAC) motor drives. **(10 Marks)**

OR

10 a. Explain important features and applications of brushless dc motor drives. **(07 Marks)**

b. What are the different types of steel rolling mills? Explain any one type and requirements of motor for that drive. **(07 Marks)**

c. What are the required features of the motors used in machine tools? **(06 Marks)**

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CBCS SCHEME

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18EE742

Seventh Semester B.E. Degree Examination, June/July 2024
Utilization of Electrical Power

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Mention the advantages of electrical heating over other forms of heating. **(06 Marks)**

b. With a neat diagram, explain the working of direct arc furnace. Mention its applications. **(06 Marks)**

c. A resistance oven employing nichrome wire is to be operated from 220 V, single phase supply and is rated at 16 KW. If the temperature of the limited to 1170°C, and the average temperature of the charge is 500°C, find the diameter and length of element wire, radiating efficiency is 0.57, emissivity = 0.9, specific resistance of nichrome 109×10^{-8} Ωm. **(08 Marks)**

OR

2 a. With a neat diagram, explain laser beam welding. **(06 Marks)**

b. A 20 cm long portion of a circular shaft 10 cm diameter is to be coated with a layer of 1.5 mm nickel, determine the quantity of electricity in Ah and the time taken for the process. Assume a current density of 195 A/sq.m and the current efficiency of 92%, specific gravity of nickel is 0.9. **(06 Marks)**

c. What is electro deposition? Discuss the factors that influence the electro deposition. **(08 Marks)**

Module-2

3 a. State and explain inverse square law and Lambert's cosine law with respect to illumination. **(06 Marks)**

b. Explain the construction and working of sodium vapour camp, with neat circuit diagram. **(06 Marks)**

c. Two lamps posts 14 meters apart and are fitted with 200 cp lamp, each at a height of 5m above the ground, calculate the illumination on the ground:
(i) Under each lamp (ii) Midway between lamps **(08 Marks)**

OR

4 a. Briefly explain polar curves. Mention its importance. **(06 Marks)**

b. Explain the measurement of mean spherical candle power by integrating sphere with neat diagram. **(06 Marks)**

c. If a lamp of 200 cp, is placed 1 meter below a plane mirror, which reflects 90% of light falling on it, determine the illumination at a point 3 meters away from foot of lamp, which hung 4 meters above the ground. **(08 Marks)**

Module-3

5 a. Discuss the direct steam engine system along with their advantages and disadvantages. **(06 Marks)**

b. A scheduled speed of 45 kmph is required between two stops 1.5 km apart. Find the maximum speed over run, if the stop is 20 seconds duration the values of acceleration and retardation are 2.4 km per hour per sec and 3.2 km per hour per second respectively. Assume simplified trapezoidal speed time curve and what is meant by scheduled speed of a train. **(06 Marks)**

c. Derive the expression for tractive effort for propulsion of train and also define tractive effort. **(08 Marks)**

OR

6 a. Explain the term: (i) Dead weight (ii) Coefficient of adhesion (iii) Adhesive weight **(06 Marks)**

b. With a neat diagram, explain the construction and working of single phase AC series motor. **(06 Marks)**

c. Discuss briefly the speed control of dc motor by field control method, mention its merits. **(08 Marks)**

Module-4

7 a. Mention the advantages and disadvantages of regenerative braking in traction. **(06 Marks)**

b. Mention the system of electric traction, briefly explain any two types. **(06 Marks)**

c. A 400-tonne train travels down a gradient 1 in 70 for 120 secs, during which its speed is reduced from 80 km/hour to 50 km/hr by regenerative braking. Find the energy returned to lines if the tractive resistance is 5 kg/tonne and allowance for rotational inertia is 7.5%, over all efficiency motors is 75%. **(08 Marks)**

OR

8 a. Mention the different types of mechanical braking, discuss compressed air brake. **(06 Marks)**

b. Write a note on tramways and trolley buses. **(06 Marks)**

c. Explain the function of negative booster in a tramway system. **(08 Marks)**

Module-5

9 a. With a relevant graph, explain traction motor characteristics. **(06 Marks)**

b. Explain tractive effort and transmission requirements for electric vehicles. **(06 Marks)**

c. Explain the conceptual illustration of general EV configuration. **(08 Marks)**

OR

10 a. Explain the conceptual illustration of hybrid electric drive train. **(06 Marks)**

b. Explain with a neat diagram, the concept of parallel hybrid electric drive train. **(06 Marks)**

c. Compare electric vehicles over conventional internal combustion engine vehicles. What are the advantages and disadvantages of series hybrid electric drives? **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | 18EE752

Seventh Semester B.E. Degree Examination, June/July 2024
Electric Vehicles

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What are Electric Vehicles? List the features of Electric Vehicles along with top level perspective diagram. **(10 Marks)**

b. With the equation, explain constant and non-constant F_{TR} on level road. **(10 Marks)**

OR

2 a. Describe the laws of motion and also mention power for i_{th} torque. **(10 Marks)**

b. Explain the dynamics of vehicle motion. **(10 Marks)**

Module-2

3 a. Define a hybrid electric vehicle and explain its advantages and disadvantages. **(06 Marks)**

b. Define and draw the block diagram of a series hybrid electric vehicle. **(07 Marks)**

c. Define and draw the block diagram of a parallel hybrid electric vehicle. **(07 Marks)**

OR

4 a. What are the requirements that define the drive train architecture of hybrid vehicles? **(07 Marks)**

b. Explain the apportioning of power between the heat engine and the electric motor in a hybrid electric vehicle. **(07 Marks)**

c. Draw and explain a series-parallel combination hybrid electric vehicle. **(06 Marks)**

Module-3

5 a. Explain the construction of a lead acid battery. **(10 Marks)**

b. Explain the reaction in each electrode during charging and discharging of a lead acid battery. **(10 Marks)**

OR

6 a. Discuss the compounds used in a lithium ion battery. **(10 Marks)**

b. Explain the reactions in a lithium-ion battery during charging and discharging. **(10 Marks)**

Module-4

7 a. Explain various types of motors that can be used in an electric vehicle. **(06 Marks)**

b. Explain V/f control of induction motor for electric vehicle. **(07 Marks)**

c. Explain vector control of an induction motor. **(07 Marks)**

OR

8 a. Explain abc to $\alpha\beta$ conversion in the context of AC drives for electric vehicles. **(10 Marks)**

b. Explain the use of synchronous motors in electric vehicles. **(10 Marks)**

CBCS SCHEME

USN | | | | | | | | | |

18EE752

Seventh Semester B.E. Degree Examination, June/July 2024
Electric Vehicles

Time: 3 hrs. Max. Marks: 100

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3 a. Define a hybrid electric vehicle and explain its advantages and disadvantages. **(06 Marks)**

b. Define and draw the block diagram of a series hybrid electric vehicle. **(07 Marks)**

c. Define and draw the block diagram of a parallel hybrid electric vehicle. **(07 Marks)**

OR

4 a. What are the requirements that define the drive train architecture of hybrid vehicles? **(07 Marks)**

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b. Explain V/f control of induction motor for electric vehicle. **(07 Marks)**

c. Explain vector control of an induction motor. **(07 Marks)**

OR

8 a. Explain abc to αβ conversion in the context of AC drives for electric vehicles. **(10 Marks)**

b. Explain the use of synchronous motors in electric vehicles. **(10 Marks)**

Module-5

9 a. Explain in detail the general torque-speed envelope of an electric motor drive and its various zones of operation. **(07 Marks)**

b. Explain when the need for gears arises and what is a differential gear. **(07 Marks)**

c. Define maximum gradability of an electric vehicle if the maximum tractive force is F_{+r} and the weight of the vehicle is "M". **(06 Marks)**

OR

10 a. What is the six-step operation mode of a three-phase bridge inverter for an electric vehicle? **(07 Marks)**

b. Explain sinusoidal pulse with modulation of a three-phase bridge inverter for an electric vehicle. **(07 Marks)**

c. Explain the transmission system requirement of an electric vehicle. **(06 Marks)**

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18EE754

Seventh Semester B.E. Degree Examination, June/July 2024
Electrical Energy Conservation and Auditing

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the following terms with three examples for each:
i) Primary and secondary energy ii) Commercial and Non commercial energy
iii) Renewable and Non renewable energy **(12 Marks)**
b. Explain about Green house effect and the Acid rain. **(08 Marks)**

OR

2 a. Explain about energy security. **(08 Marks)**
b. Explain Energy Conservation Act 2001 with any 6 features. **(12 Marks)**

Module-2

3 a. Explain need for electrical load management and step by step approach for maximum demand control. **(12 Marks)**
b. Explain the advantages of power factor improvement and cost benefits of PF improvement. **(08 Marks)**

OR

4 a. Explain Soft Starter with its advantages. **(06 Marks)**
b. Explain Automatic power factor controllers. **(06 Marks)**
c. Explain any 4 Energy efficient lighting controls **(08 Marks)**

Module-3

5 a. Explain about ten step methodology for detailed audit. **(12 Marks)**
b. Explain the need for energy audit and types of energy audit. **(08 Marks)**

OR

6 a. Explain any 4 key instruments for energy audit. **(08 Marks)**
b. Explain energy audit report format in detail. **(12 Marks)**

Module-4

7 a. Explain distinguishing features of electricity as commodity. **(12 Marks)**
b. Explain four pillar market design. **(08 Marks)**

OR

8 a. Explain with block diagram the mechanism of available based tariff. **(12 Marks)**
b. Explain in brief about framework of Indian power sector. **(08 Marks)**

Module-5

9 a. Explain about water audit methodology. **(08 Marks)**
b. Describe any 6 general energy saving tips applicable to new as well as existing building. **(06 Marks)**
c. Explain the evolution of DSM concept. **(06 Marks)**

OR

10 a. Explain DSM-planning and implementation. **(12 Marks)**
b. Explain application of load control (any 4) of DSM. **(08 Marks)**

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

18 VIII sem. EE

CBCS SCHEME

USN | | | | | | | | | | | **18EE81**

Eighth Semester B.E. Degree Examination, June/July 2024
Power System Operation and Control

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Discuss the various operating states of power system with neat block diagram. **(06 Marks)**
b. What is energy control center? Explain the functions of energy control center. **(07 Marks)**
c. List out the objectives of power system control. Explain the various controls involved. **(07 Marks)**

OR

2 a. With a neat diagram, explain the components of RTU (Remote Terminal Unit). **(08 Marks)**
b. What are Intelligent Electronic Devices [IED's]? Explain its functional block diagram. **(07 Marks)**
c. Discuss the classification of SCADA system with neat sketches wherever necessary. **(05 Marks)**

Module-2

3 a. Explain the AVR and ALFC control loops with schematic block diagram. **(07 Marks)**
b. Explain the different modes of Governer operation. **(05 Marks)**
c. Draw the schematic diagram of a steam turbine governing system and explain the functions of various components. **(08 Marks)**

OR

4 a. Obtain the transfer function for the complete ALFC system. **(10 Marks)**
b. Obtain the overall expression of an AGC with PI controller from its relevant block diagram representation of ALFC. **(10 Marks)**

Module-3

5 a. Obtain the state space model of an isolated system with necessary equations. **(10 Marks)**
b. Explain the two area load frequency control with neat block diagram and necessary equations. **(10 Marks)**

OR

6 a. With a schematic block diagram, explain Automatic Voltage Control (AVR). With necessary equations and mathematical models. **(10 Marks)**
b. Explain the decentralized control of AGC. **(04 Marks)**
c. Two generators rated 200 MW and 400 MW are operating in parallel. Their droop characteristics are 4% and 5% respectively from no load to full load. The speed changers are so set that the generators operate at 50 Hz sharing a full load of 600 MW in the ratio of their ratings. If the load reduces to 400 MW, how will it be shared among the generators and what will be the system frequency? **(06 Marks)**

18. VIII Sem. EE

CBCS SCHEME

USN | | | | | | | | | | |

18EE81

Eighth Semester B.E. Degree Examination, June/July 2024
Power System Operation and Control

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Discuss the various operating states of power system with neat block diagram. **(06 Marks)**

b. What is energy control center? Explain the functions of energy control center. **(07 Marks)**

c. List out the objectives of power system control. Explain the various controls involved. **(07 Marks)**

OR

2 a. With a neat diagram, explain the components of RTU (Remote Terminal Unit). **(08 Marks)**

b. What are Intelligent Electronic Devices [IED's]? Explain its functional block diagram. **(07 Marks)**

c. Discuss the classification of SCADA system with neat sketches wherever necessary. **(05 Marks)**

Module-2

3 a. Explain the AVR and ALFC control loops with schematic block diagram. **(07 Marks)**

b. Explain the different modes of Governer operation. **(05 Marks)**

c. Draw the schematic diagram of a steam turbine governing system and explain the functions of various components. **(08 Marks)**

OR

4 a. Obtain the transfer function for the complete ALFC system. **(10 Marks)**

b. Obtain the overall expression of an AGC with PI controller from its relevant block diagram representation of ALFC. **(10 Marks)**

Module-3

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OR

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b. Explain the decentralized control of AGC. **(04 Marks)**

c. Two generators rated 200 MW and 400 MW are operating in parallel. Their droop characteristics are 4% and 5% respectively from no load to full load. The speed changers are so set that the generators operate at 50 Hz sharing a full load of 600 MW in the ratio of their ratings. If the load reduces to 400 MW, how will it be shared among the generators and what will be the system frequency? **(06 Marks)**

Module-4

7 a. Explain briefly the various elements of power system that can generate or absorb reactive epower. **(10 Marks)**

b. Show that the real power flow between two nodes is determined by the transmission angle, and the reactive power flow is determined by the scalar voltage difference between the nodes. **(10 Marks)**

OR

8 a. Explain the different methods of voltage control by reactive power injection. **(10 Marks)**

b. With neat diagram, explain Booster transformers and phase shift transformers used for voltage control. **(06 Marks)**

c. Discuss the process of voltage collapse with a neat sketch. **(04 Marks)**

Module-5

9 a. Explain the security constrained optimal power flow with the help of an example showing various states involved. **(07 Marks)**

b. List out the factors affecting the Power System Security. **(05 Marks)**

c. With a neat flow chart, discuss the process involved in AC power flow security analysis with contingency case selection. **(08 Marks)**

OR

10 a. With neat diagrams and necessary equations, explain:
(i) Generation shift factors
(ii) Line outage distribution factors **(10 Marks)**

b. Explain the linear least square estimation technique used for state estimation in power system with flow chart. **(10 Marks)**

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CBCS SCHEME

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18EE824

Eighth Semester B.E. Degree Examination, June/July 2024

Power System Planning

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What do you mean by planning process? Mention the step-by-step procedure to planning action with block diagram. **(10 Marks)**

b. Explain different power planning organization business models. **(10 Marks)**

OR

2 a. Explain Enterprise Resources Planning [ERP] requirements for electric power system with neat block diagram. **(10 Marks)**

b. Explain different forecasting techniques used in power system planning. **(10 Marks)**

Module-2

3 a. With block diagram, explain private participation with respect to ownership options and modes of participation in power system planning. **(10 Marks)**

b. Explain the concept of credit-risk assessment for a power project during construction and operational stage. **(10 Marks)**

OR

4 a. Explain clean coal technologies used in coal based plants. **(10 Marks)**

b. Explain the assessment studies required for renovation and modernization of Thermal power plant. **(10 Marks)**

Module-3

5 a. Explain the criteria for transmission planning in power system. **(10 Marks)**

b. What are the reasons and advantages favouring HVDC transmission lines? **(10 Marks)**

OR

6 a. Explain Grid formulation and compare existing grid and smart grid. **(06 Marks)**

b. Explain technical and economic aspect for planning density and size of substation in power system. **(06 Marks)**

c. Mention and explain different conductors used in transmission system. **(08 Marks)**

Module-4

7 a. Explain the basic planning principles of distribution planning. **(10 Marks)**

b. What are the different basic distribution network used by utilities and explain radial and loop system with figure. **(10 Marks)**

OR

8 a. Explain generation Reliability planning critera and Transmission Reliability criteria. **(10 Marks)**

b. Explain the causes for quality of supply problems for a consumer. **(05 Marks)**

c. With flow diagram, explain reliability cost analysis. **(05 Marks)**

Module-5

9 a. What is demand response? Explain demand response planning with block diagram. **(10 Marks)**

b. What are the principles for the electricity market? **(10 Marks)**

OR

10 a. Name different types of power markets. **(05 Marks)**

b. List out the methods to solve optimal bidding problem. **(05 Marks)**

c. Briefly explain types of congestion management to manage transmission capacity in power system. **(10 Marks)**

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21-III Sem. EE

CBCS SCHEME

USN | | | | | | | | | | |

21EE33

Third Semester B.E. Degree Examination, June/July 2024
Electric Circuit Analysis

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following networks with example :
i) Linear and Nonlinear Network
ii) Bilateral and Unilateral Network
iii) Active and Passive network. **(06 Marks)**

b. Using source transformation, determine the power delivered by 50 V source in given network Fig.Q1(b) below.

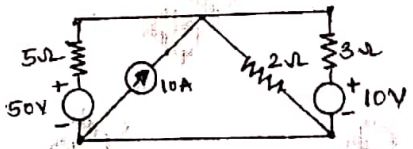

Fig.Q1(b) **(07 Marks)**

c. Determine I_x and V_x for the circuit shown in Fig.Q1(c) below, using mesh analysis.

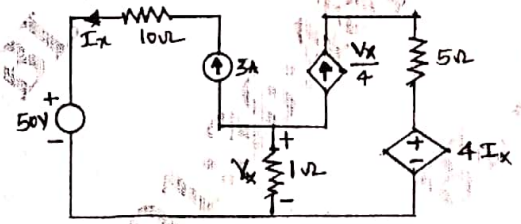

Fig.Q1(c) **(07 Marks)**

OR

2 a. Obtain expressions to convert star connected impedances into equivalent delta connected impedances. **(06 Marks)**

b. Explain the concept of supermesh using network and also mention steps to apply Mesh analysis. **(07 Marks)**

c. Determine the power dissipation in 10 ohm resistor using nodal analysis, shown in Fig.Q2(c).

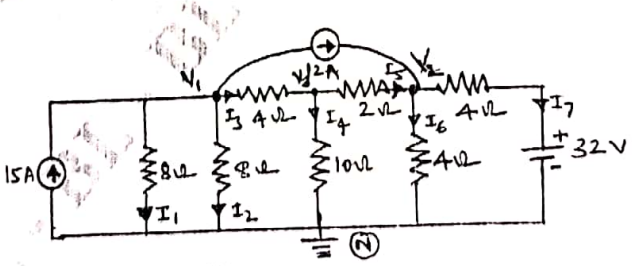

Fig.Q2(c) **(07 Marks)**

Module-2

3 a. State Thevenin's theorem. Explain it with the help of networks. Mention the steps to apply Thevenin's theorem and also limitations of Thevenin's theorem. **(10 Marks)**

b. State Norton's theorem and determine the Norton's equivalent circuit across AB terminals in Network shown in Fig.Q3(b). Also draw Thevenin's equivalent across AB.

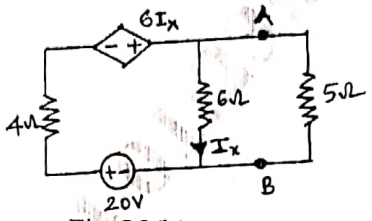

Fig.Q3(b) **(10 Marks)**

OR

4 a. State and explain maximum power transfer theorem using suitable networks and also prove the maximum power transfer theorem. **(10 Marks)**

b. By using superposition theorem, determine the current through the (4 + j3) impedance shown in Fig.Q4(b) Network.

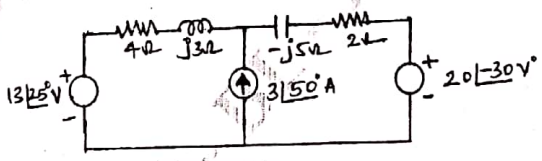

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Define the following :
i) Resonance ii) Q-factor iii) Selectivity iv) Bandwidth **(04 Marks)**

b. Explain the behaviour of R, L, C elements for transients. Mention their representation at the time of switching. **(06 Marks)**

c. The network shown in Fig.Q5(c) below is under steady state condition with switch K is at position 1. Determine expression for i(t) if switch K is moved to position 2. Draw variation of i(t).

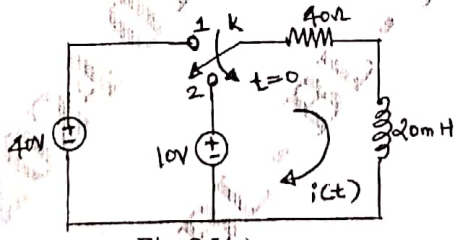

Fig.Q5(c) **(10 Marks)**

OR

6 a. Show that Resonant frequency is geometric mean of two half power frequencies. **(04 Marks)**

b. It is required that a series RLC circuit should resonate at 1 MHz. Determine values of R, L and C if bandwidth of circuit is 5 kHz and its impedance is 50 Ω at resonance. **(06 Marks)**

c. In circuit shown in Fig.Q6(c), determine complete solution for current, when switch K is closed at t = 0. Applied voltage is V(t) which is given, $100\cos(10^3 t + \pi/2)$.

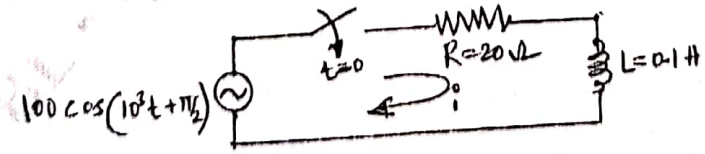

Fig.Q6(c) **(10 Marks)**

Module-4

7 a. Mention advantages and disadvantages of Laplace transform. **(04 Marks)**

b. State and prove Final Value theorem as applied to Laplace transform. **(06 Marks)**

c. Synthesis the waveform shown in Fig.Q7(c). Determine Laplace transform of periodic waveform.

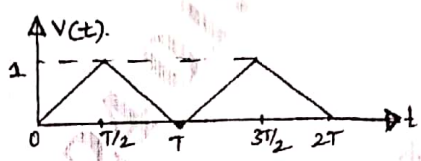

Fig.Q7(c) **(10 Marks)**

OR

8 a. Obtain Laplace transform of a Ramp function. **(04 Marks)**

b. Determine Laplace transform of a following :

i) $\sin^2 t$ ii) $\cos^2 t$ **(06 Marks)**

c. Calculate the voltage $V_c(t)$ for $t \geq 0$ for the circuit shown below using Laplace transform method. In the circuit shown Fig.Q8(c) switch is opened at t = 0.

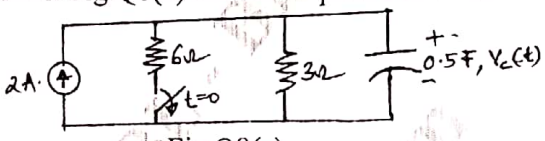

Fig.Q8(c) **(10 Marks)**

Module-5

9 a. Define port of network and write assumptions to be made to find network and also obtain Z-parameters. **(10 Marks)**

b. An unbalanced 3-phase load is supplied by symmetrical 3 phase, 440V, 3 wire system. The star connected load branch are $Z_R = 5\angle 30°$, $Z_y = 10\angle 45°$, $Z_B = 10\angle 60°$. Determine line currents. **(10 Marks)**

OR

10 a. Discuss the method of analyzing 3-phase star connected unbalanced load using mesh method. **(10 Marks)**

b. Determine h-parameter of network shown in Fig.Q10(b) and give its equivalent circuit.

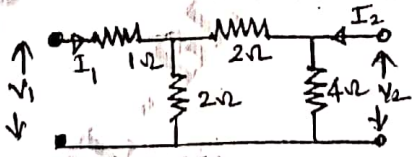

Fig.Q10(b) **(10 Marks)**

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CBCS SCHEME

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21EE34

Third Semester B.E. Degree Examination, June/July 2024
Transformers and Generators

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the operation of 1-ph transformer under no-load condition. **(06 Marks)**

b. Draw the equivalent circuit of 1-phase transformer referred to primary side. **(06 Marks)**

c. A transformer has its maximum efficiency of 0.98 at 15 KVA at unity p.f. During a day it is loaded as follows:
12 Hours 2 kW at 0.8 p.f
6 Hours 12 kW at 0.8 p.f
6 Hours 18 kW at 0.9 p.f
Find the all-day efficiency. **(08 Marks)**

OR

2 a. With neat schematic diagram, explain the construction of three phase transformer. **(06 Marks)**

b. With circuit diagram, explain the working principle of scott connection for three to two phase conversion. **(06 Marks)**

c. Consider a 4 KVA, 200/400 V single phase transformer supplying full load current at 0.8 lagging power factor. The OC/SC Tests results are as follows :
OC Test : 200 V, 0.8 A, 70 W (LV side)
SC Test : 20 V, 10 A, 60 W (HV side)
(i) Calculate efficiency, secondary voltage and current into primary at the above load.
(ii) Calculate the load at unity power factor corresponding to maximum efficiency. **(08 Marks)**

Module-2

3 a. Explain the necessity and conditions for parallel operation of 1-phase transformers. **(06 Marks)**

b. Show that how two transformers will share the load with equal ratios. **(06 Marks)**

c. Two 100-KW, single phase transformers are connected in parallel both on the primary and secondary. One transformer has an ohmic drop of 0.5% at full load and an inductive drop of 8% at full load current. The other has an ohmic drop of 0.75% and inductive drop of 2%. Show how will they share a load of 180 kW at 0.9 power factor. **(08 Marks)**

OR

4 a. Discuss the necessary conditions for parallel operation of 3-phase transformers. **(06 Marks)**

b. With neat circuit connection, explain the working principle of Auto Transformer. **(06 Marks)**

c. A two winding transformer is rated at 2400/240 V, 50 KVA. It is re-connected as a step-up auto-transformer, with 2400 V input. Calculate the rating of auto-transformer and the inductively and conductively transferred powers while delivering the rated output at unity power factor. **(08 Marks)**

Module-3

5 a. Discuss the advantages of three winding transformer. **(06 Marks)**

b. Explain the process of Armature reaction in D.C. Generators. **(06 Marks)**

c. Determine per pole the number, (i) of cross-magnetising ampere-turns (ii) of back ampere turns and (iii) of series turns to balance the back ampere-turns in the case of a dc generator having the following data:
500 conductors, total current 200 A, 6 poles, 2-circuit wave winding, angle of load = 10°, leakage coefficient = 1.3 **(08 Marks)**

OR

6 a. Explain the following terms :
(i) Demagnetising Ampere-turns
(ii) Cross magnetizing Ampere-turns. **(06 Marks)**

b. Explain the following terms :
(i) Distribution or Breadth factor
(ii) Winding factor or Spread factors. **(06 Marks)**

c. Calculate the RMS value of the induced e.m.f per phase of a 10-pole 3-ph 50 Hz alternator with 2 slots per pole per phase and 4-conductors per slot in two layers. The coil span is 150°. The flux per pole has a fundamental component of 0.12 wb and a 20% third component. **(08 Marks)**

Module-4

7 a. Explain the method determining the Regulation by synchronous impedance method. **(10 Marks)**

b. In a 50 KVA, star connected, 440 V, 3-phase, 50 Hz alternator, the effective armature resistance is 0.25 ohm per phase, the synchronous reactance is 3.2 Ω per phase and leakage reactance is 0.5 Ω per phase. Determine at rated load and unity power factor.
(i) Internal emf
(ii) No-load emf E_0.
(iii) Percentage Regulation on full load.
(iv) Value of synchronous reactance which replaces armature reaction. **(10 Marks)**

OR

8 a. Explain the method finding the voltage regulation by zero-power factor or Potier method. **(10 Marks)**

b. The open and short circuit test readings for a 3-d star-connected, 1000 KVA, 2000 V, 50 Hz synchronous generators are,

Field amps :	10	20	25	30	40	50
OC Testinal :	800	1500	1760	2000	2350	2600
SC armature current :	-	200	250	300	-	-

The armature effective resistance is 0.2 Ω per phase. Draw the characteristic curves and estimate the full-load percentage regulation at,
(i) 0.8 pf lagging
(ii) 0.8 pf leading **(10 Marks)**

Module-5

9 a. Explain the necessity and advantages of parallel operation and explain the condition for proper synchronization of alternators. **(10 Marks)**

b. A 3-phase, 50 Hz, 2 pole alternator is excited to generate the bus bar voltage of 11 KV at no-load. Calculate synchronizing power per degree of mechanical displacement of the rotor. The machine in star connected and the short circuit current for this excitation is 1200 A. Neglect armature winding resistance. **(10 Marks)**

OR

10 a. Explain the method of finding X_d and X_q of synchronous machine (slip test). **(10 Marks)**

b. Explain the power angle characteristics of salient pole synchronous machines under loaded condition. **(10 Marks)**

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21EE

CBCS SCHEME

USN | | | | | | | | | | |

21EE34

Third Semester B.E. Degree Examination, June/July 2024
Transformers and Generators

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the operation of 1-ph transformer under no-load condition. **(06 Marks)**

b. Draw the equivalent circuit of 1-phase transformer referred to primary side. **(06 Marks)**

c. A transformer has its maximum efficiency of 0.98 at 15 KVA at unity p.f. During a day it is loaded as follows:
12 Hours 2 kW at 0.8 p.f
6 Hours 12 kW at 0.8 p.f
6 Hours 18 kW at 0.9 p.f
Find the all-day efficiency. **(08 Marks)**

OR

2 a. With neat schematic diagram, explain the construction of three phase transformer. **(06 Marks)**

b. With circuit diagram, explain the working principle of scott connection for three to two phase conversion. **(06 Marks)**

c. Consider a 4 KVA, 200/400 V single phase transformer supplying full load current at 0.8 lagging power factor. The OC/SC Tests results are as follows :
OC Test : 200 V, 0.8 A, 70 W (LV side)
SC Test : 20 V, 10 A, 60 W (HV side)
(i) Calculate efficiency, secondary voltage and current into primary at the above load.
(ii) Calculate the load at unity power factor corresponding to maximum efficiency. **(08 Marks)**

Module-2

3 a. Explain the necessity and conditions for parallel operation of 1-phase transformers. **(06 Marks)**

b. Show that how two transformers will share the load with equal ratios. **(06 Marks)**

c. Two 100-KW, single phase transformers are connected in parallel both on the primary and secondary. One transformer has an ohmic drop of 0.5% at full load and an inductive drop of 8% at full load current. The other has an ohmic drop of 0.75% and inductive drop of 2%. Show how will they share a load of 180 kW at 0.9 power factor. **(08 Marks)**

OR

4 a. Discuss the necessary conditions for parallel operation of 3-phase transformers. **(06 Marks)**

b. With neat circuit connection, explain the working principle of Auto Transformer. **(06 Marks)**

c. A two winding transformer is rated at 2400/240 V, 50 KVA. It is re-connected as a step-up auto-transformer, with 2400 V input. Calculate the rating of auto-transformer and the inductively and conductively transferred powers while delivering the rated output at unity power factor. **(08 Marks)**

Module-3

5 a. Discuss the advantages of three winding transformer. **(06 Marks)**

b. Explain the process of Armature reaction in D.C. Generators. **(06 Marks)**

c. Determine per pole the number, (i) of cross-magnetising ampere-turns (ii) of back ampere turns and (iii) of series turns to balance the back ampere-turns in the case of a dc generator having the following data:
500 conductors, total current 200 A, 6 poles, 2-circuit wave winding, angle of load = 10°, leakage coefficient = 1.3 **(08 Marks)**

OR

6 a. Explain the following terms :
(i) Demagnetising Ampere-turns
(ii) Cross magnetizing Ampere-turns. **(06 Marks)**

b. Explain the following terms :
(i) Distribution or Breadth factor
(ii) Winding factor or Spread factors. **(06 Marks)**

c. Calculate the RMS value of the induced e.m.f per phase of a 10-pole 3-ph 50 Hz alternator with 2 slots per pole per phase and 4-conductors per slot in two layers. The coil span is 150°. The flux per pole has a fundamental component of 0.12 wb and a 20% third component. **(08 Marks)**

Module-4

7 a. Explain the method determining the Regulation by synchronous impedance method. **(10 Marks)**

b. In a 50 KVA, star connected, 440 V, 3-phase, 50 Hz alternator, the effective armature resistance is 0.25 ohm per phase, the synchronous reactance is 3.2 Ω per phase and leakage reactance is 0.5 Ω per phase. Determine at rated load and unity power factor.
(i) Internal emf
(ii) No-load emf E_0.
(iii) Percentage Regulation on full load.
(iv) Value of synchronous reactance which replaces armature reaction. **(10 Marks)**

OR

8 a. Explain the method finding the voltage regulation by zero-power factor or Potier method. **(10 Marks)**

b. The open and short circuit test readings for a 3-d star-connected, 1000 KVA, 2000 V, 50 Hz synchronous generators are,

Field amps :	10	20	25	30	40	50
OC Testinal :	800	1500	1760	2000	2350	2600
SC armature current :	-	200	250	300	-	-

The armature effective resistance is 0.2 Ω per phase. Draw the characteristic curves and estimate the full-load percentage regulation at,
(i) 0.8 pf lagging
(ii) 0.8 pf leading **(10 Marks)**

Module-5

9 a. Explain the necessity and advantages of parallel operation and explain the condition for proper synchronization of alternators. **(10 Marks)**

b. A 3-phase, 50 Hz, 2 pole alternator is excited to generate the bus bar voltage of 11 KV at no-load. Calculate synchronizing power per degree of mechanical displacement of the rotor. The machine in star connected and the short circuit current for this excitation is 1200 A. Neglect armature winding resistance. **(10 Marks)**

OR

10 a. Explain the method of finding X_d and X_q of synchronous machine (slip test). **(10 Marks)**

b. Explain the power angle characteristics of salient pole synchronous machines under loaded condition. **(10 Marks)**

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21-IVsem. EE

CBCS SCHEME

USN | | | | | | | | | | |

21EE42

Fourth Semester B.E. Degree Examination, June/July 2024
Digital System Design

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Obtain a minimal SOP expression for the function f(a, b, c, d,e) = Σm(3, 7, 11, 12, 13, 14, 15, 16, 18) + d(24, 25, 26, 27, 28, 29, 30, 31) using Karnaugh map method. **(08 Marks)**

b. Design a combinational logic circuit to output the 2's complement of a 4-but binary number
i) Construct the truth table
ii) Simplify each output function using K-map and write reduced equations and draw the resulting logic diagram. **(12 Marks)**

OR

2 a. Find a minimal sum for the following Boolean function using Quine – Mc Cluskey method and prime implicant table reduction f(a, b, c, d) = Σ(3, 4, 5, 7, 10, 12, 14, 15) + ϕ(2). **(12 Marks)**

b. Obtain the minimal sum using K-map for the following function f(a, b, c, d) = Σm(1, 2, 3, 5, 6, 7, 11, 12, 13 14, 15). Find all the prime implicants and essential prime implicants. Draw the logic diagram. **(08 Marks)**

Module-2

3 a. Implement full subtractor using a decoder and write the truth table. **(06 Marks)**
b. Design even parity generator circuit for 4 bit I/P using multiplexer. **(08 Marks)**
c. Write a note on 4-bit priority encoder. **(06 Marks)**

OR

4 a. Design a 2-bit comparator using gates. **(10 Marks)**
b. Explain how a full subtractor can be realized using two half subtractor and OR-Gate. **(10 Marks)**

Module-3

5 a. Draw the logic symbol of the edge triggered JK flip-flop. Obtain its characteristics equations and draw the timing diagram. **(08 Marks)**
b. Explain different types of triggering mechanism employed in flip-flops. **(06 Marks)**
c. Draw the logic circuit of D latch using only NAND gates and explain its operation. **(06 Marks)**

OR

6 a. Explain how T-flip-flop can be converted into SR flipflop. **(07 Marks)**
b. Write the truth table for the following circuit and show that it acts as a T-flip-flop.

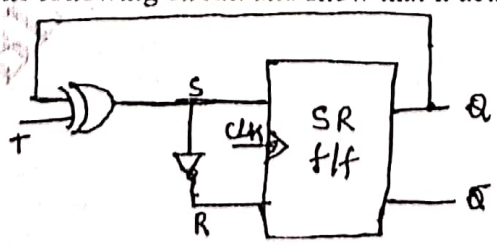

Fig Q6(b) **(07 Marks)**

c. Distinguish between i) Synchronous and Asynchronous circuits ii) Combinational and sequential circuits. **(06 Marks)**

Module-4

7 a. Design a synchronous counter with sequence 0, 1, 3, 7, 6, 4, 0 using JK flip flop. **(08 Marks)**

b. Design a 4-bit binary ripple up counter using negative edge triggered JK f/f. **(04 Marks)**

c. List the steps involved in the design of asynchronous counter. **(08 Marks)**

OR

8 a. Draw a 4 bit Johnson counter, its truth table and timing diagram. Explain its operation. **(08 Marks)**

b. Explain the operation of 4-bit bidirectional shift register. **(08 Marks)**

c. List the applications of shift registers. **(04 Marks)**

Module-5

9 a. Distinguish between Mealy and Moore model with necessary block diagram. **(08 Marks)**

b. Analyze the synchronous circuit of the figure shown Q9(b) i) Write the excitation and output function ii) Form the excitation and state tables.

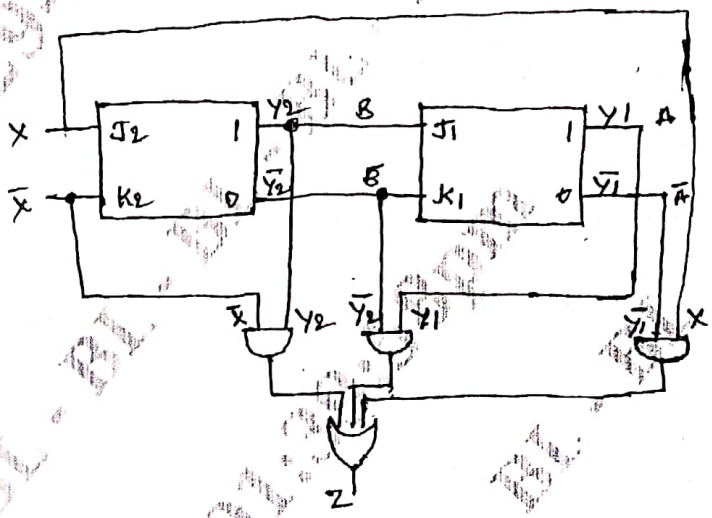

Fig Q9(b) **(12 Marks)**

OR

10 a. Obtain the transition table for the state diagram shown below Fig Q10(a) and design a sequential circuit using JK flip-flop.

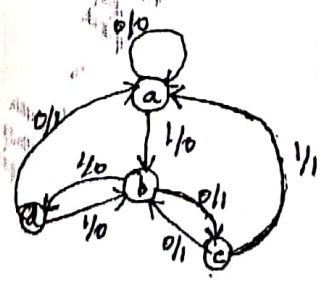

Fig Q10(a) State diagram **(08 Marks)**

b. Explain the classification of semiconductor memories. **(04 Marks)**

c. Discuss the following types of ROM memory i) EPROM ii) PROM iii) EEPROM. **(08 Marks)**

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CBCS SCHEME

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21EE44

Fourth Semester B.E. Degree Examination, June/July 2024
Electric Motors

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. What is back emf? Explain its significance briefly. **(06 Marks)**

b. Explain the characteristics of DC shunt motor with suitable diagrams. **(06 Marks)**

c. A 4-pole lap wound Dc motor has 576 conductors and draws an armature current of 10A. If magnetic flux per pole is 0.02 wb, calculate the armature torque developed. What will the value of this torque if the motor is wave wound? **(08 Marks)**

OR

2 a. Derive the torque equation of a DC motor. **(04 Marks)**

b. Explain the characteristics of a DC series motor with suitable diagrams. **(06 Marks)**

c. With a neat diagram, explain the construction and operation of a 3-point starter. **(10 Marks)**

Module-2

3 a. Compare direct and indirect methods of testing DC motors. **(04 Marks)**

b. Briefly explain Swinbunne's test. **(08 Marks)**

c. Explain why Hopkinson's test is called a Back-to-Back test. **(08 Marks)**

OR

4 a. Derive the torque equation of a 3-phase induction motor. **(06 Marks)**

b. Clearly explain slip, slip speed and percentage slip. **(06 Marks)**

c. A 3-phase, 50Hz induction motor runs at 1490 rpm at no load. Calculate the slip, percentage slip and slip speed. If the full load speed of this motor is 1450rpm, what are the values of slip, percentage slip and slip speed? **(08 Marks)**

Module-3

5 a. Draw and explain the equivalent circuit of the rotor of a 3-phase induction motor. How is the mechanical load on the motor is shown in this equivalent circuit? **(06 Marks)**

b. With a diagram, explain the construction and operation of a double cage induction motor. **(07 Marks)**

c. Explain how blocked rotor is conducted on a 3-phase induction motor. **(07 Marks)**

OR

6 a. Explain the phenomenon of cogging and crawling in a 3-phase induction motor. **(06 Marks)**

b. With a neat diagram, explain how maximum output, maximum torque and maximum input are calculated by using the circle diagram of a 3-phase induction motor. **(06 Marks)**

c. A 3-phase, start connected induction motor takes a stator current of 30A at a line voltage of 40 volts, with the rotor blocked. Under this condition, the power input to the motor is 500 walts and core loss is 50 watts. If the DC resistance between a pair of stator terminals is 0.12Ω and the ratio of AC to DC resistance is 1.62, find the equivalent leakage reactance/phase of the motor, per phase stator resistance and per phase rotor resistance. **(08 Marks)**

Module-4

7 a. Mention the limitations of star-delta starter. **(06 Marks)**

b. Explain rotor resistance starting with a neat diagram. **(06 Marks)**

c. Explain the speed control of a 3-phase induction motor by controlling input voltage and frequency. **(08 Marks)**

OR

8 a. Explain double field revolving theory as applicable to single phase induction motors. **(10 Marks)**

b. With a neat diagram, explain the construction and operation of a shaded pole induction motor. **(10 Marks)**

Module-5

9 a. Briefly explain why synchronous motor is not self starting. **(06 Marks)**

b. Write a note on hunting and damping in synchronous motors. **(08 Marks)**

c. Explain the operation of universal motor. **(06 Marks)**

OR

10 a. Explain V and inverted V curves briefly. Give suitable diagrams. **(08 Marks)**

b. Write a note on synchronous condenser. **(06 Marks)**

c. Explain the operation of linear induction motor. **(06 Marks)**

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CBCS SCHEME

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21MATCS41

Fourth Semester B.E. Degree Examination, June/July 2024
Mathematical Foundations for Computing, Probability and Statistics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Provide data table book.***

Module-1

1 a. Define tautology. Show that the compound proposition $[p \rightarrow (q \rightarrow r)] \rightarrow [(p \rightarrow q) \rightarrow (p \rightarrow r)]$ is a tautology for any propositions p, q, r. **(06 Marks)**

b. Prove that (i) $p \vee [p \wedge (p \vee q)] \equiv p$ (ii) $[(\neg p \vee \neg q) \rightarrow (p \wedge q \wedge r)] \equiv p \wedge q$ using the laws of logic. **(07 Marks)**

c. Prove that for all integers k and ℓ is k and ℓ are both odd, then $k + \ell$ is even and $k\ell$ is odd. **(07 Marks)**

OR

2 a. Define: (i) Universal quantifiers (ii) Existential quantifiers, with an example. **(06 Marks)**

b. Test the validity of the following argument.
I will become famous or I will not become a musician.
I will become a musician.
Therefore I will become famous. **(07 Marks)**

c. Suppose the universe consist of integers. Consider the following open statements:
$p(x) : x \leq 3$, $q(x) : x + 1$ is odd $r(x) : x > 0$
Write down the truth values of:
(i) p(2) (ii) $\vee$q (4) (iii) $p(-1) \wedge q(1)$ (iv) $\sim p(3) \vee r(0)$
(v) $p(0) \rightarrow q(0)$ (vi) $p(1) \leftrightarrow \sim q(2)$ (vii) $p(4) \vee (q(1) \wedge r(2))$ **(07 Marks)**

Module-2

3 a. Let A and B be finite sets with |A| = m and |B| = n. Find how many one to one functions are possible from A to B. If there are 60 1 – 1 functions from A to B and |A| = 3, what is |B|? **(06 Marks)**

b. Let A = {1, 2, 3, 4, 6, 12} and R be a relation on A defined by aRb if "a is a multiple of b". Write down the relation R, relation matrix M(R) and draw its digraph. **(07 Marks)**

c. Define: (i) Null graph (ii) Bipartite graph (iii) Euler circuit. Give an example for each. **(07 Marks)**

OR

4 a. Draw the Hasse diagram representing the positive divisors of 48. **(06 Marks)**

b. Consider the functions f and g defined by $f(x) = x^3$ and $g(x) = x^2 + 1 \ \forall \ x \in R$. Find gof, fog, f^2. **(07 Marks)**

c. Define isomorphism of graphs. Prove that 2 graphs below are isomorphic.

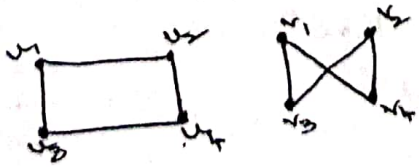

Fig.Q.4(c) **(07 Marks)**

Module-3

5 a. Find the correlation coefficient between the speed and the stopping distance and the equations of regression lines.

Speed, x	16	24	32	40	48	56
Stopping distance, y	0.39	0.75	1.23	1.91	2.77	3.81

(06 Marks)

b. Fit a best curve of the form $y = ax^b$ for the following data:

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

(07 Marks)

c. Fit a straight line by the method of least squares.

x	1	2	3	4	5
y	14	13	9	5	2

(07 Marks)

OR

6 a. The following are the percentage of marks in 2 subjects of 9 students. Find the rank correlation coefficient.

x	38	50	42	61	43	55	67	46	72
y	41	64	70	75	44	55	62	56	60

(06 Marks)

b. Fit a 2nd degree parabola $y = a + bx + cx^2$ for the data:

x	0	1	2	3	4	5
y	1	3	7	13	21	31

(07 Marks)

c. Given that $8x - 10y + 66 = 0$ and $40x - 18y = 214$ are the regression equations. Find the means of x and y and correlation coefficient. Find σ_y if $\sigma_x = 3$. **(07 Marks)**

Module-4

7 a. A random variable X has the following probability function:

x	–2	–1	0	1	2	3
P(x)	0.1	K	0.2	2K	0.3	K

Find: (i) K (ii) $P(X < 1)$ (iii) $P(X > -1)$ **(06 Marks)**

b. Find the mean and standard deviation of Poisson distribution. **(07 Marks)**

c. The mean weight of 500 students in a school is 50 kgs and the standard deviation is 6 kgs. Assuming that the weights are normally distributed, find the expected number of students weighing (i) between 40 and 50 kg (ii) more than 60 kg. Given that A(1.67) = 0.4525. **(07 Marks)**

OR

8 a. Find the constant K such that

$$f(x) = \begin{cases} Kx^2, & 0 \le x \le 3 \\ 0, & \text{elsewhere} \end{cases}$$

is a probability density function. Find the mean. **(06 Marks)**

b. When an honest coin is tossed 4 times, find the probability of getting:
(i) exactly one head (ii) atmost 3 heads (iii) at least 2 heads **(07 Marks)**

c. The probability that an individual suffers a bad reaction from a certain injection is 0.001. Using Poisson distribution, find the probability that out of 2000 individuals:
(i) exactly 3 (ii) more than 2 will suffer a bad reaction. **(07 Marks)**

Module-5

9 a. X and Y are independent random variables such that X takes 1, 5 with probabilities $\frac{1}{2}, \frac{1}{2}$ respectively. Y takes –4, 2, 7 with probabilities $\frac{3}{8}, \frac{3}{8}$ and $\frac{1}{4}$ respectively. Find the joint probability distribution of X and Y. Find Cov (X, Y). **(06 Marks)**

b. Find the student 't' for the following variables values in a sample of eight –4, –2, –2, 0, 2, 2, 3, 3 taking the mean of the universe to be zero. **(07 Marks)**

c. The following are the I.Q's of a randomly chosen sample of 10 boys: 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Does this data support the hypothesis that the population mean of I.Q's is 100 at 5% level of significance? **(07 Marks)**

OR

10 a. Explain the terms:
(i) Null hypothesis
(ii) Alternate hypothesis
(iii) Levels of significance
(iv) Type 1 and Type 2 errors **(06 Marks)**

b. A die is thrown 60 times and the frequency distribution for the number appearing on the face x is given by the following table:

x	1	2	3	4	5	6
Frequency	15	6	4	7	11	17

Test the hypothesis that the die is unbiased. Use Chisquare test at 5% level of significantly. **(07 Marks)**

c. The nine items of a sample have the following values 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ significantly from the assumed mean of 47.5 ($t_{0.05} = 2.31$). **(07 Marks)**

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21-V Sem - EE

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21EE51

Fifth Semester B.E. Degree Examination, June/July 2024
Transmission and Distribution

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain typical line diagram of transmission and distribution scheme indicating voltage levels used at different stages. **(06 Marks)**

b. Deduce an approximate expression for sag in overhead lines when supports are at unequal levels. **(06 Marks)**

c. An insulator string has 3 units, each having a safe working voltage of 15 kV, the capacitance between each insulator pin and earth is 10% of self capacitance of each insulator. Calculate
i) Maximum safe working voltage of the string ii) String efficiency. **(08 Marks)**

OR

2 a. Explain any two methods to improve the string efficiency. **(06 Marks)**

b. With suitable expression, explain the advantages of high transmission voltage. **(06 Marks)**

c. A transmission line conductor is supported on the towers of unequal heights. The first tower has a height of 30m and the second tower has a height of 50m. The distance between the towers is 150m. Tension in the conductor is 2200 kg and cross section of the conductor is 2 cm^2. The specific gravity of the conductor material 9.5 gm/cm^3 and wind pressure is 150 kg/cm^2. Calculate the sag. **(08 Marks)**

Module-2

3 a. Derive an expression for inductance per phase of a 3-ϕ overhead transmission line when conductors are symmetrically placed. **(08 Marks)**

b. Explain the concept of Self GMD and Mutual GMD. **(06 Marks)**

c. A 3-phase, 50 Hz, 66 kV overhead conductor are placed in a horizontal plane as shown in Fig.Q3(c). The conductor diameter is 1.25cm. The line length is 100 km. Calculate : (i) Capacitance per phase ; (ii) Charging current per phase. Assume complete transposition of the line.

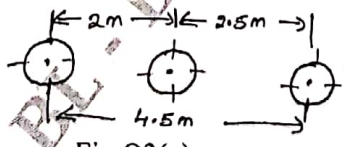

Fig.Q3(c) **(06 Marks)**

OR

4 a. Derive an expression for capacitance of a 3-phase line with unsymmetrical spacing but transposed. **(10 Marks)**

b. The three conductors of a 3-phase line are arranged at the three corners of a triangle of sides 2m, 2.5m and 4.5m. Calculate the inductance per km of the line when conductors are regularly transposed. The diameter of each line conductor is 1.24cm. **(10 Marks)**

Module-3

5 a. Derive an expression for A, B, C, D constant of a medium transmission line, using nominal π method of analysis. Show that AD – BC = 1. **(10 Marks)**

b. A single phase overhead transmission line delivers 1100 kW at 33 kV at 0.8 p.f. lagging. The load resistance and inductive reactance of the line are 100 ohms and 15 ohms respectively. Determine (i) Sending end voltage (ii) Sending end power factor (iii) Transmission efficiency with circuit diagram, with vector diagram. **(10 Marks)**

OR

6 a. Derive the expression for voltage regulation and transmission efficiency of a single phase short transmission line with the help of vector diagram. **(10 Marks)**

b. Find the following for a single circuit transmission line delivering a load of 50 MVA at 110 kV and 0.8 lagging. (i) Sending end voltage (ii) Sending end current (iii) Sending end power (iv) Efficiency of transmission. Given $A = D = 0.93\angle 3^\circ$, $B = 110^\circ\angle 75^\circ\ \Omega$, $C = 0.0005\angle 80^\circ$ siemen. **(10 Marks)**

Module-4

7 a. Explain the phenomenon of corona in overhead transmission line. Also discuss the factor affecting the corona. **(10 Marks)**

b. A single core 66 kV cable has a conductor diameter of 2 cm and a sheath of inside diameter 5.3 cm. The cable has an inner layer of 1 cm thickness of rubber with dielectric constant 4.5 and the rest is impregnated paper with dielectric constant 3.6. Find the maximum stress in each dielectric. **(10 Marks)**

OR

8 a. What are the methods of grading the cable? Explain the capacitance grading of cable. **(10 Marks)**

b. Draw the cross sectional view of single core cable and explain its construction. **(10 Marks)**

Module-5

9 a. Briefly explain the radial and ring main distribution scheme. **(10 Marks)**

b. The Fig.Q9(b) show a two wire distribution system. Calculate the voltage at each load. The resistance of each conductor is 0.03 Ω/km.

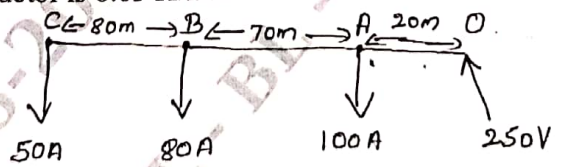

Fig.Q9(b) **(10 Marks)**

OR

10 a. What is Power Quality? What are the different Power Quality problems? **(10 Marks)**

b. Draw the schematic diagram and hence obtain the expressions for voltages at different tappings of a DC distributed fed at one end with concentrated loads. **(10 Marks)**

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CBCS SCHEME

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21EE52

Fifth Semester B.E. Degree Examination, June/July 2024
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Control System? What are the requirements of a good control system? **(06 Marks)**

b. Obtain the transfer function of the given network shown in Fig.Q.1(b). **(06 Marks)**

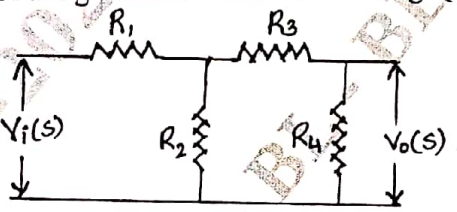

Fig.Q.1(b)

c. For the system shown in Fig.Q.1(c), draw the electrical network based on torque current analogy give all the performance equation. **(08 Marks)**

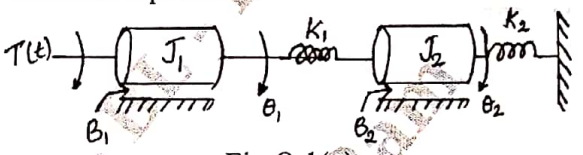

Fig.Q.1(c)

OR

2 a. For the mechanical system shown in Fig.Q.2(a). Draw the mechanical network and obtain the FV analogous electrical systems. **(08 Marks)**

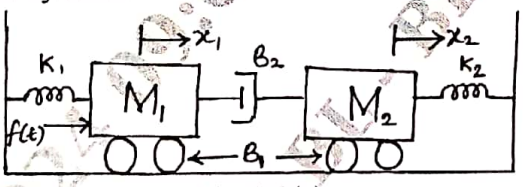

Fig.Q.2(a)

b. Derive the transfer function of an armature controlled dc motor. **(06 Marks)**

c. Explain the procedure to plot the synchro pair characteristics of synchronous receiver and transmitter. **(06 Marks)**

Module-2

3 a. Determine $\frac{C(S)}{R(S)}$ using block diagram reduction technique shown in Fig.Q.3(a). **(10 Marks)**

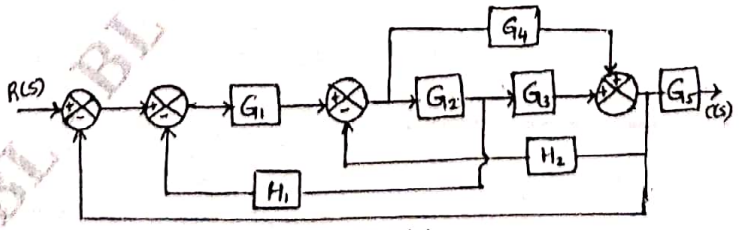

Fig.Q.3(a)

b. State Mason's gain formula. Draw the signal flow graph and find the transfer function shown in Fig.Q.3(b) **(10 Marks)**

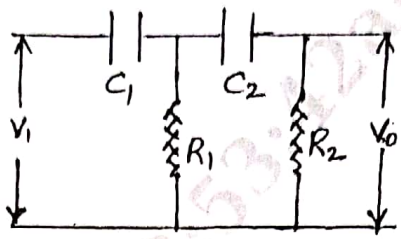

Fig.Q.3(b)

OR

4 a. Explain the following terms in block diagram reduction:
i) Moving a summing point after a block.
ii) Moving a branch point (take off point) ahead of a block.
iii) Eliminating a forward path.
iv) Interchanging a summing point and take off point. **(10 Marks)**

b. Draw the signal flow graph for the system described by the following set of equations and obtain the ratio of output x_o to input x_i using Mason's gain formula.

$x_2 = x_1 - x_6$
$x_3 = G_1x_2 - H_2x_4 - H_3x_5$
$x_4 = G_2x_3 - H_6x_6$
$x_5 = G_3x_4$
$x_6 = G_4x_5$ **(10 Marks)**

Module-3

5 a. Derive an expression for response of second order underdamped system for unit step input. **(06 Marks)**

b. The closed loop transfer function of a second order system is $\frac{C(S)}{R(S)} = \frac{25}{s^2+6s+25}$. Find rise time, Peak time, maximum overshoot and settling time, if the system is subjected to unit step input. Assume allowable steady state error as 2%. **(08 Marks)**

c. State R-H criterion, explain the difficulties of R-H criterion and remedy. **(06 Marks)**

OR

6 a. Explain the performance characteristics of transient response specifications to unit step input. **(06 Marks)**

b. A unity feedback system having open loop transfer function of $G(S) = \frac{K(2S+1)}{S(S+1)(S+4)^2}$. The input r(t) = 1 + 6t is applied to the system. Determine the minimum value of K. If the steady state error is to be less than 0.1. **(08 Marks)**

c. Check the stability of the given characteristic equation using R-H criterion
$S^5 + 2S^4 + 4S^3 + 6S^2 + 2S + 5 = 0$. **(06 Marks)**

Module-4

7 a. Sketch the root locus plot for the system whose OLTF is given by $G(S)H(S) = \frac{K}{(S+1)(S+3)(S+5)}$. Find the value of K for which the system is stable. Also show the line of RLP for damping ratio $\xi = 0.5$. **(10 Marks)**

b. Explain with circuit diagram and procedure to determine experimentally the frequency response of a second order system and evaluation of frequency domain specifications. **(10 Marks)**

OR

8 a. A unity feedback control system with $G(S)=\frac{10(S+10)}{S(S+2)(S+5)}$ find gain and phase margin using bode plot. **(10 Marks)**

b. Derive an expression for resonant peak and resonant frequency for a second order system. **(10 Marks)**

Module-5

9 a. State and explain the Nyquist stability criterion. **(06 Marks)**

b. Explain PI and PID controller on a second order system. **(08 Marks)**

c. Explain the step by step procedure of lead compensating network. **(06 Marks)**

OR

10 a. The open loop transfer function of a control system is $G(S)H(S)=\frac{1}{S^2(S+2)}$ sketch the Nyquist plot. Comment on stability. **(10 Marks)**

b. What is lead-lag compensation? Explain the procedure to design lead-lag compensation in frequency domain. **(10 Marks)**

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CBCS SCHEME

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21EE53

Fifth Semester B.E. Degree Examination, June/July 2024
Power System Analysis – I

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define a per unit system. State its advantages and disadvantages. **(06 Marks)**

b. Show that the pu impedance of a transformer is same either referred to primary or secondary side of it. **(06 Marks)**

c. A single line diagram of a power system is shown below in Fig. Q1 (c). Draw its pu impedance diagram.

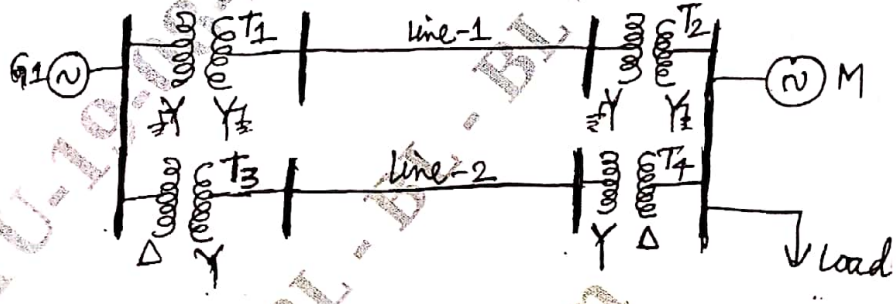

Fig. Q1 (c)

G_1 = 90 MVA, 11 KV, X″ = 18 %, M = 85 MVA, 11 KV, X″ = 13%

T_1 = 70 MVA, 11/110 KV, X = 15 %

T_2 = 60 MVA, 110/11 KV, X = 10 %

T_3 = Three 1 ϕ units each rated 10 MVA, 11/127 KV, X = 9%

T_4 = Three 1 ϕ units each rated 16.6667 MVA, 127/11 KV, X = 12%

Line – 1, Z = j80 Ω, Line – 2, Z = j120 Ω

The load absorbs 74 MVA, 0.8 pf lagging at 6.5 KV.

Select a common base of 100 MVA, 11 KV on the generator G1 side. **(08 Marks)**

OR

2 a. Draw and explain the circuit models of the following power system components in steady state mode: (i) Synchronous machine (ii) 2-winding transformer (iii) transmission line (iv) loads. **(08 Marks)**

b. Define a single line diagram. List out any four important components in power system and draw its symbol used in its single line diagram. **(04 Marks)**

c. A 3-lens power system is shown in Figure Q2 (c) below. The ratings of various components are also given below:

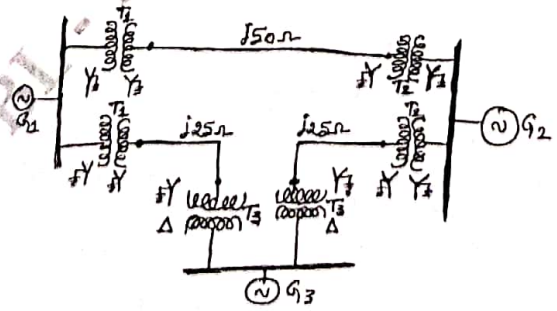

Fig. Q2 (c)

$G_1 = 50$ MVA, 13.8 KV, $X'' = 0.15$ pu ; $G_2 = 40$ MVA, 13.2 KV, $X'' = 0.2$ pu.
$G_3 = 30$ MVA, 11 KV, $X'' = 0.25$ pu ; $T_1 = 45$ MVA, 11/110 KV, $X = 0.1$ pu.
$T_2 = 25$ MVA, 12.5/115 KV, $X = 0.15$ pu ; $T_3 = 40$ MVA, 12.5/115 KV, $X = 0.1$ pu.
Determine the pu impedance diagram based on 50 MVA and 13.8 KV in generator G_1. **(08 Marks)**

Module-2

3 a. Define a fault that occur in a power system. Classify the fault and define each type. **(04 Marks)**

b. Briefly explain how a synchronous machine on no-load offers a time varying reactance when subjected to a sudden 3ϕ short circuit across its terminals. **(08 Marks)**

c. A transformer of 3ϕ rated at 50 MVA having a SC reactance of 5% is connected to the bus bar which is supplied through two 66 KV feeder cables each having an impedance of (1.5+j2.5) Ω. One of the feeders is connected to a generating station rated at 80 MVA and having a SC reactance of 10% and the other feeder is connected to another generating station rated at 100 MVA and having SC reactance of 15%. Determine the MVA at fault point in the event of a SC between secondary terminals of transformer. Choose base MVA as 400 and base KV as 66 on the generator side. **(08 Marks)**

OR

4 a. A single line diagram of a simple 3-lens power system is shown in Fig. Q4 (a) below. All the impedances are expressed in pu on a common base of 100 MVA and respective base KVs. Assume all generators are running at their rated voltage. Determine the fault current and the currents through generators during the fault when a balanced 3ϕ fault with a fault impedance of j0.16 pu occurs on bus 3.

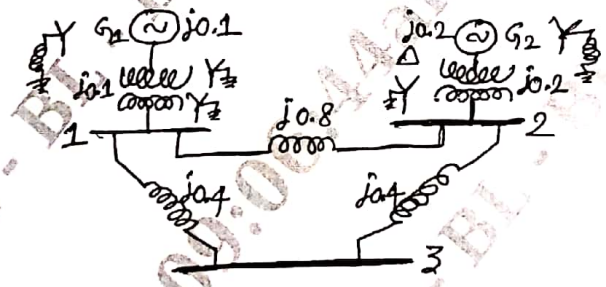

Fig. Q4 (a) **(10 Marks)**

b. Explain with a neat circuit model, the short circuit transients on a transmission line with the assumptions involved. Also explain the doubing effect on the line under 3ϕ short circuit with the neat waveforms of currents. **(10 Marks)**

Module-3

5 a. Determine the symmetrical components of the asymmetrical phasors given below :
$V_R = 100\angle 250^\circ$ volts, $V_Y = 50\angle -110^\circ$ volts and $V_B = 40\angle 100^\circ$ volts. **(06 Marks)**

b. For the power system shown below in Fig. Q5 (b), draw all the sequence networks in pu. Choose a base of 50 MVA, 220 KV in j50 Ω transmission lines and mark all reactances in pu. The ratings of the components are,
$G_1 = 25$ MVA, 11 KV, $X''_d = 20\%$,
$G_2 = 25$ MVA, 11 KV, $X''_d = 20\%$,
T_1 to T_4 : Three 1ϕ units each rated at 6.6667 MVA, 6.35 KV/127 KV, X = 15%.
The negative sequence reactance of each machine is its subtransient reactance. The zero sequence reactance of each machine is 8%. Assume that the zero sequence reactances of lines are 250% of their positive sequence reactance's.

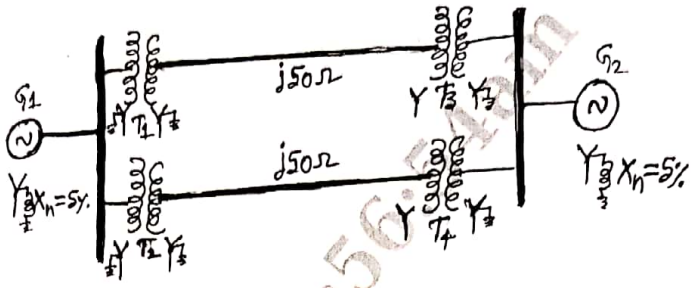

Fig. Q5 (b) **(14 Marks)**

OR

6 a. The symmetrical components of phase A in a 3ϕ-Y connected system of phase voltages are $V_{a1} = 200\angle 30^\circ V$, $V_{a2} = 60\angle 60^\circ V$ and $V_{a0} = 20\angle -30^\circ V$. The symmetrical components of line currents of phase A are, $I_{a1} = 20\angle 10^\circ A$, $I_{a2} = 5\angle 20^\circ A$ and $I_{a0} = 3\angle -10^\circ A$. Determine the 3ϕ power in KVA and also in pu, if the base power is 1 KVA. Also compute the active and reactive powers. **(06 Marks)**

b. A single line diagram of the power system is shown in Fig. Q6 (b) below. The positive, negative and zero sequence reactances of the components are given below along with their ratings. Draw the positive, negative and zero sequence networks of this power system on the base of generator ratings.

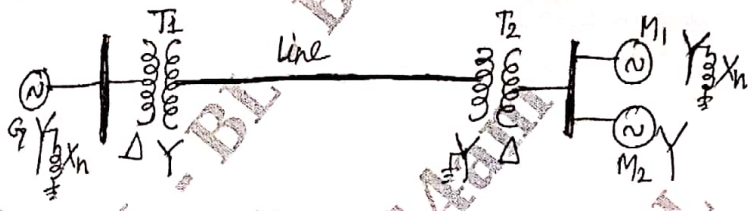

Fig. Q6 (b)

G : 30MVA, 13.8 kV, $X'' = 0.15$ pu, $X_2 = 0.15$ pu and $X_0 = 0.05$ pu, $X_n = 2\ \Omega$
M_1: 20 MVA, 12.5 KV, $X'' = 0.2$ pu, $X_2 = 0.15$ pu and $X_0 = 0.05$ pu, $X_n = 2\ \Omega$
M_2: 10 MVA, 12.5 KV, $X'' = 0.2$ pu, $X_2 = 0.15$ pu and $X_0 = 0.05$ pu,
T_1: 35 MVA, 13.2/115 KV, X = 0.1 pu
T_2: Three 1 ϕ units each rated at 10 MVA, 12.5/67 KV, X = 0.1 pu
Line : $X_1 = X_2 = 80\ \Omega$ and $X_0 = 250\ \Omega$ **(14 Marks)**

Module-4

7 A 25 MVA, 11 KV 3 ϕ generator has a subtransient reactance of 20 %. The generator supplies two motors over a transmission line with transformers at both ends. The motors have rated inputs of 15 and 7.5 MVA, both at 10 KV with the subtransient reactance of 25%. The 3ϕ transformers are both rated at 30 MVA, 10.8/121 KV with a leakage reactance of 10% each. The series reactance of the line is 100 Ω. Assume that the negative sequence reactance of each machine is equal to its sub-transient reactance. Also, assume the zero sequence reactances for the generator and motors as 0.06 pu on its own ratings. The current limiting reactors of 2.5 Ω each are connected in the neutral of generator and motor. The zero sequence reactance of the line is 300 Ω. Select a base of 25 MVA and 11 KV in generator circuit, then draw the positive, negative and zero sequence networks of the system. If a solid LG fault occurs at the point F as shown in Fig. Q7 below, calculate the fault current at the fault point F. Neglect the prefault current.

Fig. Q7 **(20 Marks)**

OR

8 a. List out and explain the different types of open conductor faults occurs in a power system. **(06 Marks)**

b. Derive an equation of fault current, if a LLG fault occurs with a fault impedance Z_f on an unloaded synchronous generator, whose neutral is grounded through an impedance Z_n. The generator has balanced emfs and sequence impedances of Z_1, Z_2 and Z_0. **(08 Marks)**

c. A 3ϕ, 50 MVA, 11 KV, Y-connected, neutral solidly grounded generator operating on no-load at rated voltage gave the following sustained fault currents for the specified faults. Determine the three sequence impedances in Ω and also in pu for the base values of 50 MVA and 11 KV.
3ϕ fault : 2000 A, L – L fault : 1800 A, L-G fault : 2200 A **(06 Marks)**

Module-5

9 a. Derive a swing equation of a synchronous generator connected to an infinite bus bar with usual notations. **(08 Marks)**

b. Define steady state stability and transient stability. List out the ways to improve their limits. **(06 Marks)**

c. A 50 Hz, four pole turbo generator rate 100 MVA, 11 KV has an inertia constant of 8 MJ/MVA :
(i) Find the stored energy in the rotor at synchronous speed.
(ii) If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW, find the rotor acceleration neglecting mechanical and electrical losses.
(iii) If the above mentioned acceleration is maintained for 10 cycles, find the change in torque angle and rotor speed at the end of this period. **(06 Marks)**

OR

10 a. Derive a power angle equation of a non-salient pole synchronous machine as generator with usual notations. **(08 Marks)**

b. Define Equal Area Criterion and explain it in detail applicable for stability. **(06 Marks)**

c. A 50 Hz, four pole turbo generator rated at 20 MVA, 11 KV has an inertia constant of 9 KWsec/KVA. Find the kinetic energy stored in the rotor at synchronous speed. Determine the acceleration if the input powerless the rotational losses is 26,800 HP and the electric power developed is 16 MW. If the acceleration computed for the generator is constant for a period of 10 cycles, determine the change in torque angle in that period and the change in speed in rpm at the end of cycles. Assume that the generator is synchronized with infinite lens and has no accelerating torque before 10 cycle period begins. **(06 Marks)**

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E53

CBCS SCHEME

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21EE54

Fifth Semester B.E. Degree Examination, June/July 2024
Power Electronics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. With neat circuit diagram, input and output waveform, explain the different types of power electronics converters. **(10 Marks)**

b. Explain the control characteristics of the following: (i) SCR (ii) BJT **(06 Marks)**

c. List applications of power electronic system. **(04 Marks)**

OR

2 a. With neat circuit diagram, explain the diode characteristics. **(08 Marks)**

b. With neat circuit diagram, explain the Freewheeling diodes with RL load. **(08 Marks)**

c. The reverse recovery time of a diode is t_{rr} = 3 μs and the rate of fall of the diode current is $\frac{di}{dt}$ = 30 A/μs. Determine: (i) The storage charge Q_R and (ii) The peak reverse current I_{RR}. **(04 Marks)**

Module-2

3 a. Draw static characteristic and switching characteristics of a MOSFET and explain the switching characteristics of a MOSFET. **(10 Marks)**

b. For the transistor switch of Fig.Q3(b) has the following parameters are given V_B = 10 V, R_B = 0.75 Ω, V_{BE} = 1.5 V, V_{CE} = 1.0 V, R_C = 11 Ω and V_{CC} = 200 Volts. Find:

(i) The value of R_B that results in saturation with over drive factor of 5

(ii) Forced β_f

(iii) The power loss in the transistor

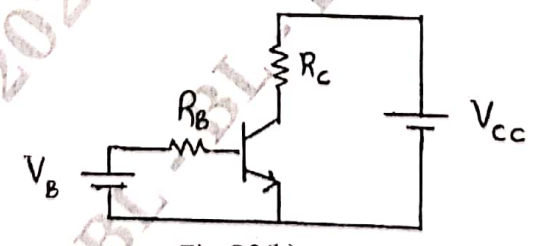

Fig.Q3(b) **(10 Marks)**

OR

4 a. Explain the different types of base drive control circuit for BJT. **(14 Marks)**

b. A simple transistor switch is used to connect a 24 volt DC supply across a relay coil, which has a DC resistance of 200 Ω. An input pulse of 0 to 5 V amplitude is applied through a series base resistor R_B at the base so as to turn ON the transistor switch. Calculate:

(i) I_{CS}

(ii) Value of R_B required to obtain over drive factor of 2

(iii) Total power dissipation in the transistor that occurs during the saturation state.

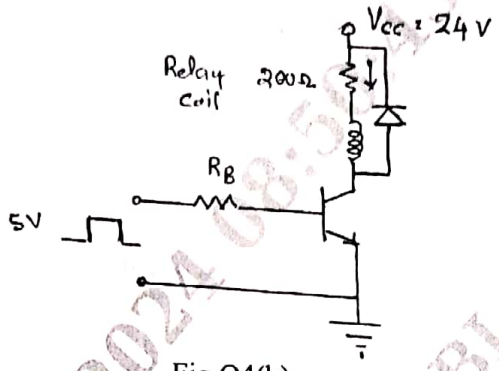

Fig.Q4(b) **(06 Marks)**

Module-3

5 a. Explain the V-I characteristics of SCR. **(08 Marks)**

b. Using two transistor analogy, derive an expression for anode current of SCR. **(08 Marks)**

c. If the latching current in the circuit shown in Fig.Q5(c) is 4 mA. Obtain the minimum width of the gating pulse required to properly turn-ON the SCR.

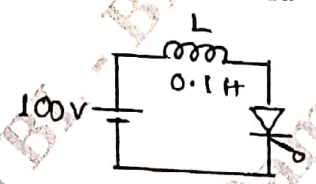

Fig.Q5(c) **(04 Marks)**

OR

6 a. How many SCRs are required in a series string to withstand a DC voltage of 3500 volts in steady-state? If the SCRs have a steady-state voltage rating of 1000 V and the steady-state derating factor is 30%. Assuming the minimum difference in the leakage current of SCRs to be 10 mA. Calculate the value of voltage sharing resistance to be used. Draw the circuit showing the SCRs and the voltage sharing resistance. **(08 Marks)**

b. Explain RC full-wave triggering circuit. **(06 Marks)**

c. Explain UJT triggering circuit. **(06 Marks)**

Module-4

7 a. With neat circuit diagram and waveform, explain single phase semi-converter with R-load. **(08 Marks)**

b. With neat circuit diagram and waveform, explain single-phase full converters with RLE load. **(12 Marks)**

OR

8 a. With the help of neat diagram and explain the operation of single phase bidirectional AC voltage controller for resistive load. **(10 Marks)**

b. An AC voltage controller with ON-OFF control has an input of 230 V, 50 Hz is connected to a resistive load of 20Ω. The circuit is operating with the switch ON for 30 cycles and OFF for 30 cycles. Determine :

(i) RMS output voltage, current

(ii) Input power factor. **(05 Marks)**

c. Why short duration pulses are not suitable for inductive loads? **(05 Marks)**

Module-5

9 a. With the help of a circuit diagram, describe the principle of step-down chopper with R load. **(06 Marks)**

b. With the help of a circuit diagram, describe the operation of set-up chopper. **(06 Marks)**

c. The DC chopper in Fig.Q9(c) has a resistive load of R = 10 Ω and the input voltage is V_S = 220 Volts, when the chopper switch remains ON, its voltage drop is V_{ch} = 2 Volts and the chopping frequency is f = 1 kHz. If the duty cycle is 50%. Determine:

(i) The average output voltage V_a
(ii) The rms output voltage V_0
(iii) The chopper efficiency
(iv) The effective input resistance R_i of the chopper.

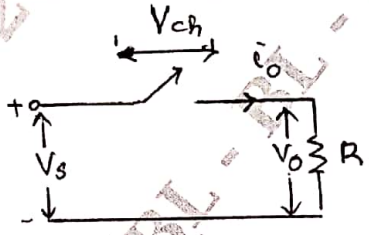

Fig.Q9(c) **(08 Marks)**

OR

10 a. Explain single-phase full-bridge inverter operation with R load. **(10 Marks)**

b. With the help of neat sketches of circuit diagram and waveforms, explain the operation of 3-phase inverter in 180 degree conduction mode. **(10 Marks)**

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