CBCS SCHEME

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17EE71

Seventh Semester B.E. Degree Examination, Jan./Feb.2021
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. Develop the relation between I_{BUS}, V_{BUS} and Y_{BUS} by assuming no mutual coupling between transmission lines of a 3-bus system. **(07 Marks)**

b. Derive the power flow equations and what are the specified practical limits of variables. **(06 Marks)**

c. Find the Y_{BUS} by direct inspection method for a system with the following data:

Element No.	1	2	3
Bus code (i – k)	1 – 2	2 – 3	3 – 1
Line impedence (pu)	j0.04	j0.02	j0.05
Half-line charging admittance (pu)	j0.02	j0.01	j0.04

(07 Marks)

OR

2 a. Define the following terms with an example:
(i) Oriented graph (ii) Tree and (iii) Co-tree **(05 Marks)**

b. Write the algorithm of Gauss-Siedel load flow solution for a power system with a slack bus and (n-1) number of PQ buses. **(08 Marks)**

c. The positive sequence reactances in pu are given for the network shown in Fig. Q2 (c). Take node-G as the reference bus. Form Y_{BUS} by singular transformation.

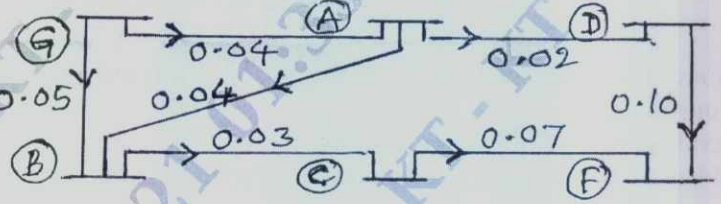

Fig. Q2 (c)

(07 Marks)

Module-2

3 a. Write the iterative algorithm for NR method of load flow analysis of power system having both PQ and PV buses. **(08 Marks)**

b. Explain the decoupled Newton method for load flow solution. **(06 Marks)**

c. Compare the Newton Raphson and Fast decoupled load flow methods with different parameters. **(06 Marks)**

OR

4 a. What are the simplifications and assumptions made in Fast Decoupled Load Flow method? **(06 Marks)**

b. Explain how the voltage profile is controlled by synchronous generators and VAR generators. **(07 Marks)**

c. Derive the Jacobian matrix elements equations from the load flow equations. **(07 Marks)**

Module-3

5 a. Explain the following terms in the optimal operation of generators :
(i) Input Output curve (ii) Heat rate curve (iii) Incremental fuel cost curve. **(06 Marks)**

b. Explain the optimal generation scheduling considering transmission losses. **(09 Marks)**

c. What are the needs and importance of unit commitment? **(05 Marks)**

OR

6 a. With the assumptions made, derive the formula of transmission loss and hence B- coefficients for a two-plants system. **(08 Marks)**

b. With random unit performance record obtain the probability of a unit being in up or down states for system reliability. **(05 Marks)**

c. A constant load of 300 MW is supplied by two 200 MW generators for which the incremental fuel costs are: $\frac{dC_1}{dP_{G_1}} = 0.1P_{G_1} + 20$ and $\frac{dC_2}{dP_{G_2}} = 0.12P_{G_2} + 15$

Determine:
(i) The most economical division of load between the generators
(ii) The saving in Rs./day there by obtained compared to equal load sharing between machines. **(07 Marks)**

Module-4

7 a. Explain the optimal power flow solution without inequality constraints. **(08 Marks)**

b. Explain the solution technique for hydrothermal scheduling problem. **(07 Marks)**

c. Briefly, explain the functions of system security analysis. **(05 Marks)**

OR

8 a. State the mathematical formulation of hydrothermal system with assumptions and constraints. **(10 Marks)**

b. Explain the loss of load probability. **(04 Marks)**

c. What are the inequality constaints on control variables in optimal power flow? **(06 Marks)**

Module-5

9 a. Explain the algorithm for short circuit studies of an n-bus system. **(10 Marks)**

b. For the power system shown in Fig. Q9 (b) the reactances are given in pu. A solid three phase fault occurs on bus-3. Calculate (i) Fault current (ii) all bus voltages (iii) Fault current in the lines. **(10 Marks)**

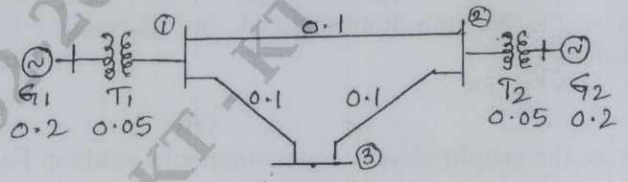

Fig. Q9 (b)

OR

10 a. Explain with relevant diagrams, the point by point method of solving the swing equation. **(10 Marks)**

b. Derive the generalize algorithm for finding the elements of Z_{BUS} when a branch is,
(i) Added between an old bus and reference bus
(ii) Added between two old buses. **(10 Marks)**

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17EE72

Seventh Semester B.E. Degree Examination, Jan./Feb.2021
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, explain zones of protection in a power system. **(06 Marks)**

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

c. List the merits and demerits of static relays. **(06 Marks)**

OR

2 a. Draw a neat sketch of an induction disc relay and discuss its operating principle. **(07 Marks)**

b. What are the various types of over current relays? Discuss their area of applications. **(06 Marks)**

c. Describe the realization of a overcurrent relay using numerical technique. Show its flowchart with neat diagram. **(07 Marks)**

Module-2

3 a. With a neat schematic diagram, explain the construction and working of static reactance relay using an amplitude comparator. **(08 Marks)**

b. With a neat sketch, explain the construction and working principle of induction disc type reverse power relay. **(08 Marks)**

c. With neat diagram, explain induction cup type impedance relay. **(04 Marks)**

OR

4 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)**

Module-3

5 a. With neat diagram, explain percentage differential protection of star-delta connected transformer. **(08 Marks)**

b. With neat diagram, explain the working of Buccholz relay. **(05 Marks)**

c. An 11 kV, 150 MVA alternator is provided with differential protection. The percentage of winding to be protected against phase to ground fault is 80%. The relay is set to operate when there is 20% out of balance current. Determine the value of the resistance to be placed in the neutral to ground protection. **(07 Marks)**

OR

6 a. 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)**

b. With neat diagram, explain harmonic restraint relay used to protect against magnetizing inrush current of transformer. **(08 Marks)**

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

Module-4

7 a. In a 132 kV system, reactance and capacitance upto the location of the circuit breaker is 4Ω and 0.02 μF respectively. A resistance of 500 Ω is connected across the break of the C.B. Determine the (a) natural frequency of oscillation (b) damped frequency of oscillation. (c) critical value of resistance. **(08 Marks)**

b. Explain working of SF_6 circuit breaker with the help of diagrams. Write two of its advantages. **(08 Marks)**

c. Explain recovery rate theory to explain the zero current interruption of the arc. **(04 Marks)**

OR

8 a. Derive expressions for restriking voltage and RRRV in terms of system voltage, inductance and capacitance during fault on feeder. **(08 Marks)**

b. With neat circuit diagram, explain the synthetic testing of circuit breaker. **(06 Marks)**

c. With neat diagram, explain Air-break circuit breaker. Write any two of its applications. **(06 Marks)**

Module-5

9 a. Describe the construction and operation of the HRC cartridge fuse with indicator. Write any four of advantages of HRC fuses. **(08 Marks)**

b. Describe the phenomenon of lightning and explain the terms pilot streamer, stepped leader, return streamer, dart leader, cold lightning stroke and hot lightning stroke. **(08 Marks)**

c. Write short note on Arcing horn with diagram. **(04 Marks)**

OR

10 a. Describe the construction and principle of operation of valve type lightning arrester with detailed diagram. **(08 Marks)**

b. Write note on klydonograph and magnetic link. **(06 Marks)**

c. Describe the protection of stations and sub-stations against direct lightning strokes. **(06 Marks)**

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17EE73

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
High Voltage Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive an expression for the current growth in the air gap considering Townsend First ionization co-efficient. **(10 Marks)**

b. What is Paschen's law? How do you account for the minimum voltage for breakdown under a given PXD condition? **(10 Marks)**

OR

2 a. List the three important properties of liquid dielectrics and explain suspended particle theory of breakdown. **(10 Marks)**

b. List the various breakdown mechanisms in solid dielectrics and explain Thermal breakdown mechanism. **(10 Marks)**

Module-2

3 a. What are the advantages of high frequency transformers? Explain the 3-stage cascaded transformer for generation of HVAC. **(10 Marks)**

b. A Cockcroft – Walton type voltage multiplier has eight stages with capacitances, all equal 0.05μF. The supply transformer secondary voltage is 125kN at 150Hz frequency. If the load current is 5mA find the i) Percentage Ripple ii) Regulation iii) Optimum number of stages for minimum regulation. **(10 Marks)**

OR

4 a. With a circuit diagram, explain the tripping of an impulse generation with three electrode gap arrangement. **(10 Marks)**

b. An impulse generator has eight stages with each condenser rated for 0.16μF and 125kV. The load capacitor is of 1000pF. Find the series and damping resistance needed to produce 1.2/50μs impulse wave. What is the maximum output voltage of the generator, if the charging voltage is 120kV? **(10 Marks)**

Module-3

5 a. With a neat diagram, explain the construction and working principle of Electrostatic voltmeter. **(10 Marks)**

b. Explain the various factors that affect the spark over voltage of sphere gap. **(10 Marks)**

OR

6 a. With a block diagram, explain the cathode ray oscilloscope for impulse measurement. **(10 Marks)**

b. A generating voltmeter has to be designed so that it can have a range from 20 to 200kV DC. If the indicating meter reads a minimum current of 2μA and maximum current of 25μA, what should the capacitance of generating voltmeter be? **(06 Marks)**

c. List the limitations of series resistance micro ammeter in measuring HVDC. **(04 Marks)**

Module-4

7 a. Explain the different theories of charge formation in cloud. **(10 Marks)**

b. What is direct and indirect lighting stroke? Give reasons for induced voltage on the power line due to indirect stroke. **(10 Marks)**

OR

8 a. List the parameters to be considered for the selection of surge arrester voltage rating for EHV and UHV, also explain the types of surge arresters used. **(10 Marks)**

b. A transmission line has the following line constant R = 0.1 ohm/km, L = 1.26mH/km, C = 0.009μF/km and G = 0. If the line is a 3-phase line and is charged from one end at a line voltage of 230kV, find the rise in voltage at the other end, if the line length is 400km. **(10 Marks)**

Module-5

9 a. With a necessary circuit diagram and pattern, explain discharge detection using straight detector for partial discharge measurement. **(10 Marks)**

b. A Schearing bridge with following configuration.
The electrode effective area 100cm^2 at balance
Arm AB – test object
Arm BC – Standard capacitor 100pF
Arm CD – Variable capacitor 50nF in parallel with resistor $\frac{1000}{\pi}$ ohms
Arm DA – Variable resistance 62.0/ohm
with 1mm thick Bakelite at 50Hz.
Determine the dielectric constant and loss factor. **(05 Marks)**

c. Write a note on :
i) Power frequency spark over test
ii) Hundred percent standard impulses spark over test in the view of surge arrester. **(05 Marks)**

OR

10 a. Explain the power frequency tests and impulse tests for i) Insulators ii) Bushings. **(10 Marks)**

b. Explain the different methods of conducting short circuit tests on circuit breakers. **(10 Marks)**

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17EE741

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Advanced Control Systems

Time: 3 hrs. Max. Marks: 100

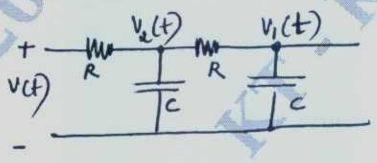
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following terms: i) State ii) State variables iii) State vector iv) State space. **(10 Marks)**

b. Obtain the state model of the electrical network shown in Fig.Q.1(b) by choosing $V_1(t)$ and $V_2(t)$ as state variables. **(10 Marks)**

Fig.Q.1(b)



OR

2 a. Obtain state variable model in Jordan canonical form for the system with transfer function

$$\frac{y(s)}{u(s)} = \frac{2s^2 + 6s + 5}{(s+1)^2(s+2)}$$ **(10 Marks)**

b. Obtain the state space representation in canonical forms of the following system

$\dddot{y} + 3\ddot{y} + 2\dot{y} = \dot{u} + u$ **(10 Marks)**

Module-2

3 a. For the matrix

$$A = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$$

i) Find the Eigen values and Eigen vectors of A

ii) Write the model matrix

iii) Show that the modal matrix indeed diagonalizes A **(10 Marks)**

b. What is state transition matrix? List out the properties of state transition matrix and advantages of state transition matrix. **(10 Marks)**

OR

4 a. Obtain the state transition matrix using:

i) Laplace Transform method

ii) Cayley Hamilton method.

$$A = \begin{bmatrix} 0 & 1 \\ -4 & -4 \end{bmatrix}$$ **(10 Marks)**

b. Determine the state controllability and observability of the system described by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$g = \begin{bmatrix} 10 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$ **(10 Marks)**

Module-3

5 For the system defined by $\dot{x} = Ax + Bu$ where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

Design a state feedback controller which will place the closed loop poles at s = (-1 ± j2) and s = -10. Determine the state feedback gain matrix k by

i) Using direct substitution method
ii) Using transformation matrix T
iii) Using Ackermann's formula. **(20 Marks)**

OR

6 a. Consider the system described by the state model

$$\dot{X} = AX,\ y = cX \text{ where } A = \begin{bmatrix} -1 & 1 \\ 1 & -2 \end{bmatrix},\ c = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

Design a full order state observer. The desired Eigen values for the observer matrix are $\mu_1 = -5$ and $\mu_2 = -5$. **(10 Marks)**

b. A regulator system has the plant

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u;\ y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$$

Design a state feedback controller which will place the closed loop poles at (-2 ± j3.464) and -5. Use Ackermann's formula. **(10 Marks)**

Module-4

7 a. What are the types of non linearities and explain them? **(10 Marks)**

b. Determine the kind of singularity for each of the following differential equations. Also locate the singular points on the phase plane i) $\ddot{y} + 0.5\dot{y} + 2y = 0$ ii) $\ddot{y} + 3\dot{y} + 2y = 0$ **(10 Marks)**

OR

8 a. What are singular points? Explain the different singular points with respect to the stability of non linear systems. **(10 Marks)**

b. Explain any one method of constructing a phase trajectory. **(10 Marks)**

Module-5

9 a. Examine the stability of the system described by the following equation by Krasovskii's theorem. $\dot{x}_1 = -3x_1 + x_2$ $\dot{x}_2 = x_1 - x_2 - x_2^3$ **(10 Marks)**

b. A second order system is described by $\dot{x} = Ax$ where $A = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix}$. Assuming matrix Q to be identify matrix, solve for P in the equation $A^TP + PA = -Q$. Use Liapunov theorem and determine the stability of the origin of the system. Write Liapunov function V(x). **(10 Marks)**

OR

10 a. Define:

i) Positive definiteness
ii) Negative definiteness
iii) Positive semi definiteness
iv) Negative semi definiteness
v) Indefiniteness. **(10 Marks)**

b. Determine whether the following quadratic form is positive definite or not

$$G(x_1, x_2) = 10x_1^2 + 4x_2^2 + x_3^2 + 2x_1x_2 - 2x_2x_3 - 4x_1x_3$$ **(10 Marks)**

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17EE752

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Testing and Commissioning of Power System Apparatus

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 artificial respiration? Explain. **(10 Marks)**

b. Explain the methods of measuring insulation resistance in case of a transformer. **(10 Marks)**

OR

2 a. List out different types of transformer tanks. Explain methods of testing transformer tanks. **(10 Marks)**

b. Explain briefly the drying of transformers. **(10 Marks)**

Module-2

3 a. List out different steps to be followed while installing an alternator. **(10 Marks)**

b. List out factory tests, commissioning tests and performance tests to be conducted on alternators. **(10 Marks)**

OR

4 a. Explain line charging capacity test on alternators. **(10 Marks)**

b. Write a note on drying out of synchronous machines. **(10 Marks)**

Module-3

5 a. Explain different methods used to dry out the windings of an induction motor. **(10 Marks)**

b. Mention various stages in the installation of an Induction Motor. **(10 Marks)**

OR

6 a. Write a note on balancing the rotor while installing an Induction Motor. **(10 Marks)**

b. Explain vibration tests carried out on an Induction Motor. **(10 Marks)**

Module-4

7 a. Explain inspection, storage, handling and transportation of power cables. **(10 Marks)**

b. How is insulation strength of a cable measured? Explain. **(10 Marks)**

OR

8 a. Explain various aspects to be considered while laying underground power cables. **(10 Marks)**

b. Explain how cable faults are located using Megger. **(10 Marks)**

Module-5

9 a. What are the various steps to be followed while installing a circuit breaker? **(10 Marks)**

b. Explain the maintenance schedule of SF_6 circuit breaker. **(10 Marks)**

OR

10 a. How is the electrical insulation of a building tested before commissioning? **(10 Marks)**

b. Write a note on Testing of earthing continuity in a building wiring. **(10 Marks)**

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