CBCS SCHEME

USN | | | | | | | | | |

17EE71

Seventh Semester B.E. Degree Examination, July/August 2021

Power System Analysis – II

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Define the following terms with an illustrative example :
(i) Oriented graph (ii) Tree (iii) Co-tree **(06 Marks)**

b. The Bus Incidence matrix of a power system network is shown below. Construct the oriented graph of the system.

$$A = \begin{bmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 1 \\ -1 & -1 & -1 & 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 & -1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 \end{bmatrix}$$

(06 Marks)

c. Derive the expression from Y-bus using singular transformation. **(08 Marks)**

2 a. Explain the load flow studies procedure with expressions as per Gauss-Seidel method for power system having all types of buses. **(08 Marks)**

b. Using Gauss –Seidel load flow method compute at the end of iteration (i) Voltages at buses 2 and 3 (ii) Real and Reaction powers at the slack bus.

LINE DATA

Bus p - q	$Z_{p,q}$	Y'_{pq}
1 - 2	j0.4	j0.2
2 - 3	j0.2	j0.1
3 - 1	j0.4	j0.2

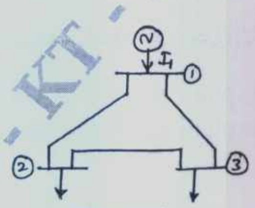

Fig.Q2(b)

INPUT DATA

Bus (i)	P_i	Q_i	V_i	Remarks
1	-	-	$1.03\angle 0^\circ$	Slack
2	-0.4	-0.3	-	PQ
3	-0.5	-0.4	-	PQ

(12 Marks)

3 a. Draw the flow chart of Newton-Raphson method in polar coordinated for load flow analysis. **(12 Marks)**

b. Find the values of x_1 and x_2 for the following equations by Newton-Raphson method upto 2^{nd} iteration.

$x_1^2 - 4x_2 - 4 = 0$; $2x_1 - x_2 - 2 = 0$ using $x_1^{(0)} = 1$ and $x_2^{(0)} = -1$. **(08 Marks)**

4 a. Deduce the fast decoupled load flow model, clearly stating all the assumptions made and give the flow chart. **(10 Marks)**

b. Explain the concept of controlling voltage profile by the use of (i) Generators (ii) VAR Generators (iii) Transformers. **(10 Marks)**

5 a. Derive the condition for minimum total fuel cost in a system comprising of K-thermal generating units, considering transmission losses. **(08 Marks)**

b. Incremental fuel costs in Rs./MWh for a plant consisting of two units are

$$\frac{dC_1}{dP_1} = 0.2P_1 + 40 \; ; \quad \frac{dC_2}{dP_2} = 0.4P_2 + 30$$

and the generator limits are as follows,

$30MW \le P_1 \le 175\ MW$

$20MW \le P_2 \le 125\ MW$

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 the load values? What are the corresponding values of the plant incremental costs? **(12 Marks)**

6 a. What is optimal unit commitment and also explain Dynamic Programming method. **(08 Marks)**

b. Explain Reliability consideration in unit commitment problem. **(06 Marks)**

c. Explain optimal generation scheduling. **(06 Marks)**

7 a. Discuss the problem formation and solution procedure of optimal scheduling for hydrothermal plants. **(10 Marks)**

b. What are transmission line loss coefficients? Derive an expression for transmission loss as a function of plant generation for a two plant system. **(10 Marks)**

8 a. Explain the major function of security analysis. **(05 Marks)**

b. Explain the three major function of system security. **(05 Marks)**

c. Write a note on :
(i) Maintenance Scheduling (ii) Power System Reliability **(10 Marks)**

9 a. Explain the algorithm for short circuit studies. **(10 Marks)**

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

10 a. Explain point-by-point solution of swing equation. **(08 Marks)**

b. Explain the steps involved in determining multimachine stability. **(05 Marks)**

c. Explain modified Euler's method of solving swing equation. **(07 Marks)**

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CBCS SCHEME

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17EE741

Seventh Semester B.E. Degree Examination, July/August 2021
Advanced Control Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

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.

1 a. Explain the concepts of state variable, state and state model of a linear system. **(06 Marks)**

b. Obtain the state model for a system represented by the following transfer function write a suitable state diagram. (Using direct decomposition method).
$T(s) = [8s^2 + 17s + 8] / [(s + 1)(s^2 + 8s + 15)]$. **(06 Marks)**

c. For the following transfer function obtain the state model in canonical form:
$$\frac{Y(S)}{U(S)} = \frac{6}{s^3 + 6s^2 + 11s + 6}$$ **(08 Marks)**

2 a. List the advantages of modern control theory over conventional control theory. **(06 Marks)**

b. Obtain the state model in phase variable form and write the block diagram for the system represented by $y''' + 6y'' + 11y' + 10y = 3u(t)$. **(06 Marks)**

c. Obtain the state space representation model for the following electrical circuit in Fig.Q.2(c). Given $R = 1M\Omega$ and $C = 1\mu F$. **(08 Marks)**

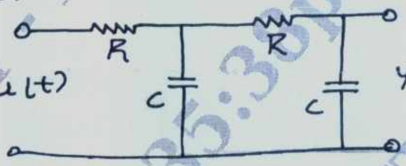

Fig.Q.2(c)

3 a. Derive the transfer function from state model. **(06 Marks)**

b. Define eigen values and eigen vectors of a matrix. **(04 Marks)**

c. Determine the transfer function of the given state vector differential equation below.
$$\begin{bmatrix} x_1^1 \\ x_2^1 \\ x_3^1 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -4 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \\ 5 \end{bmatrix} u$$ **(10 Marks)**

4 a. What is model matrix? Obtain diagonal matrix using modal matrix. **(06 Marks)**

b. State the advantages of diagonalization of a matrix. **(04 Marks)**

c. Obtain eigen values, eigen vectors and state model in canonical form for a system described by the following state model. **(10 Marks)**
$$\begin{bmatrix} x_1^1 \\ x_2^1 \\ x_3^1 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix} u \qquad y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

5 a. Prove that the necessary and sufficient condition for arbitrary pole placement is that system be completely state controllable. **(10 Marks)**

b. A regulator system has the plant

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

i) Compute K so that the control law u = -KX + r(t), r(t) = reference input, places the closed loop poles at $-2 \pm J\sqrt{12}$, -5.

ii) Design an observer such that the eigen values of the observer are located at $-2 \pm J\sqrt{12}$, -5. **(10 Marks)**

6 a. Write the block diagram of a system with observer based state feedback controller. **(10 Marks)**

b. Consider the system described by the state model $X^1 = AX$, $Y = CX$ where $A = \begin{bmatrix} -1 & 1 \\ 1 & 2 \end{bmatrix}$, C = [1 0]. Design a full order state observer. The desired eigen values for the observer matrix are $u_1 = -5$, $u_2 = -5$. **(10 Marks)**

7 a. Explain any four non-linearities in control systems. **(10 Marks)**

b. Find out singular points for the following system:

i) $y'' + 3y' - 10 = 0$ ii) $x'' + 0.5x' + 2x = 0$ **(10 Marks)**

8 a. What is a phase plane plot? Describe delta method or any other method of drawing phase plane trajectories. **(10 Marks)**

b. A linear second order servo is described by the equation $c'' + 2\xi w_n c' + w_n^2 c = 0$ where $\xi = 0.15$, $w_n = 1$ rad/sec, c(0) = 1.5 and c' = 0. Determine the singular point. Construct the phase trajectory, using the method of isoclines. **(10 Marks)**

9 a. State and explain Liapunov's theorems on

i) Asymptotic stability
ii) Global asymptotic stability
iii) Instability. **(10 Marks)**

b. Using Liapunov's direct method, find the range of K to guarantee stability of the system shown in the Fig.Q.9(b). **(10 Marks)**

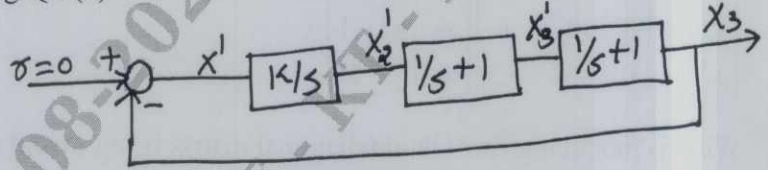

Fig.Q.9(b)

10 a. Construction of Liapunov's functions for nonlinear systems by Krosovskii's method. **(10 Marks)**

b. Determine the stability of the system described by the following equation $X^1 = AX$, $A = \begin{bmatrix} -1 & 1 \\ -2 & -4 \end{bmatrix}$. **(10 Marks)**

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