Power System Stability (BEET 704)

Course Outcomes:

CO1: Create knowledge about the stability of power system

CO2: Learners will have knowledge on small-signal stability, transient stability and voltage stability.

CO3: Will be able to understand the dynamic behaviour of synchronous generator for different disturbances.

CO4: Learners will be able to understand the various methods to enhance the stability of a power system

Model Question Paper

Q No.	Question	Marks	CO	BL	PI
1a.	What is State Space Representation?	6	1		
1b.	Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix}$ Find the Eigen values of A.	8	2		
1.c	Explain Fundamental Concepts of Stability of Dynamic Systems.	6	1		
2.a	The sending end and receiving end voltages of a three phase transmission line at a 200MW load are equal at 230KV.The per phase line impedance is j14 ohm. Calculate the maximum steady state power that can be transmitted over the line.	10	2		
2.b	A 400 MVA synchronous machine has H1=4.6 MJ/MVA and a 1200 MVA machines H2=3.0 MJ/MVA. Two machines operate in parallel in a power plant. Find out Heq relative to a 100MVA base	10	2		
3.a	What are the properties of eigenvalues and eigenvectors?	6	1		
3.b	What is the difference between mass participation factor and mode participation factor?	6	1		
3.c	Let $A = \begin{bmatrix} -3 & 15 \\ 3 & 9 \end{bmatrix}$ and let $B = \begin{bmatrix} -7 & -2 & 10 \\ -3 & 2 & 3 \\ -6 & -2 & 9 \end{bmatrix}$ Find the following:	8	2		

	1. eigenvalues and eigenvectors of A and B 2. eigenvalues and eigenvectors of A^{-1} and B^{-1} 3. eigenvalues and eigenvectors of A^T and B^T 4. The trace of A and B 5. The determinant of A and B				
4.a	A 100 MVA, two pole, 50Hz generator has moment of inertia 40 x 103 kg-m2.what is the energy stored in the rotor at the rated speed? What is the corresponding angular momentum? Determine the inertia constant h.	**10**	**2**		
4.b	Find the approximate solution of the initial value problem $\frac{dx}{dt} = 1 + \frac{x}{t}. 1 \leq t \leq 3$ with the initial condition x(1)=1, using the Runge-Kutta second order and fourth order with step size of h = 1.	**10**	**3**		
5.a	Use Runge Kutta-method 2nd order and 4th order to find the approximate solution of y(0.1) and z(0.1) as a solution of pair of equations $\frac{dx}{dt} = x + y,$ $\frac{dz}{dx} = y - x$ With the initial conditions y(0) = 1, z(0) = −1. Take step size h = 0.1	**8**	**3**		
5.b	How do you assess transient stability? What is the effect of fault clearing time on transient stability limit?	**6**	**3**		

5.c	What is small-signal stability analysis?	**6**	**1**		
6.a	Find y(0.2) for $y'=\frac{x-y}{2}$, y(0) = 1, with step length 0.1 using Modified Euler method	**10**	**3**		
6.b	A synchronous generator having a reactance of 1 p.u is connected to an infinite bus (V L0) through a transmission line. The line reactance is 0.5 p.u. Th e machine has an inertia constant of 4MW – sec/MVA. Under no load conditions, the generated emf is 1.1 p.u. Th e system frequency is 50 Hz. Calculate the frequency of natural oscillations, if the generator is loaded to 75% of its maximum power limit.	**10**	**4**		
7.a	Explain the generator tripping and what are the types of control measures for improving system stability?	**10**	**4**		
7.b	Write the expression for stabilizing signal washout stabilizer gain.	**4**	**4**		
7.c	Briefly explain the single-machine infinite bus (SMIB)configuration.	**6**	**3**		
8.a	Write short notes on: (i) Digital Stabilizer (ii) Phase lead compensation (iii) Delta –P-Omega stabilizer (iv) Digital excitation (v) Design of Phase lead compensation.	**12**	**4**		
8.b	Explain in detail with necessary equation and block diagram the Supplementary control of synchronous machine excitation using three types of PSS.	**8**	**4**		