This question paper contains 6 printed pages.

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B.Tech. / III **J**

Paper EEE–306— COMPUTER METHODS IN POWER SYSTEMS

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any five questions.

1. (*a*) Differentiate between steady state stability and transient stability of a power system. Discuss the factors that affect:

   (*i*) Steady state stability and

   (*ii*) Transient stability of the system. 7

   (*b*) A 50 Hz, four pole turbogenerator rated 100 MVA, 11 kV has an inertia constant of 8·0 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 rotor acceleration, neglecting mechanical and electrical losses.

P. T. O.

(*iii*) If the acceleration calculated in part (*ii*) is maintained for 10 cycles, find the change in torque angle and rotor speed in revolutions per minute at the end of this period. 7

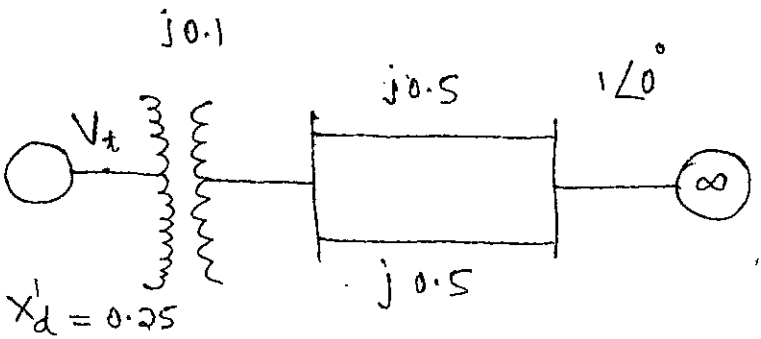
2. (*a*) Derive the Power-angle equation. 7

(*b*) The generator shown in figure, is delivering 1·0 pu power to the infinite bus ($|V|=1\cdot0$ pu), with the generator terminal voltage of $|V_t| = 1\cdot0$ pu. Calculate the generator emf behind transient reactance. Find the maximum power that can be transferred under the following conditions:

(*i*) System healthy

(*ii*) One line shorted in the middle

(*iii*) One line open. 7



3. (*a*) Explain the point-by-point solution of swing equation. 7

(*b*) A 20 MVA, 50 Hz generator delivers 18 MW over a double circuit line to an infinite bus. The generator has kinetic energy of 2·52 MJ/MVA at rated speed. The generator transient reactance is $X'_d = 0{\cdot}35$ pu. Each transmission circuit has R=0 and a reactance of 0·2 pu on a 20 MVA base. $|E'| = 1{\cdot}1$ pu and infinite bus voltage $V = 1{\cdot}0\angle 0°$. A three phase short circuit occurs at the mid point of one the transmission lines. Plot swing curves with fault cleared by simultaneous opening of breakers at both ends of the line at 2·5 cycles after the occurrence of fault. 7

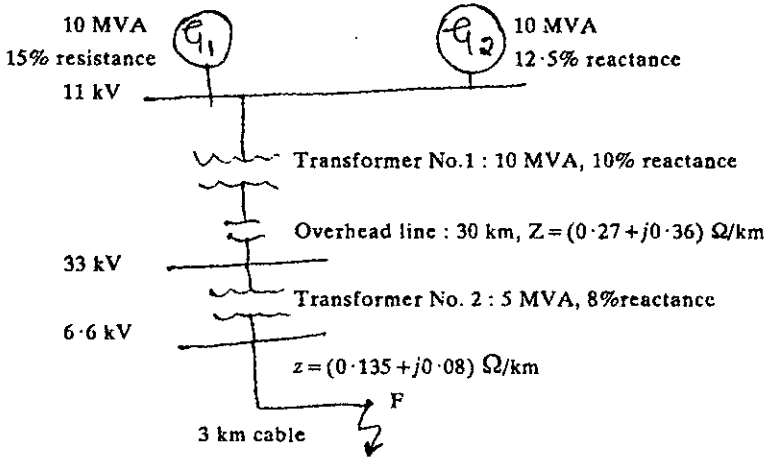
4. (*a*) Draw and explain waveform of a short circuit current of a transmission line. 7

(*b*) Calculate the Y Bus for the system shown in table below:

Line bus to bus	*R*, pu	*X*, pu
1–2	0·05	0·15
1–3	0·10	0·30
2–3	0·15	0·45
2–4	0·10	0·30
3–4	0·05	0·15

7

5. (*a*) For the radial network shown in figure, a three phase fault occurs at F. Determine the fault current and the line voltage at 11 kV bus under fault conditions. 7



(*b*) Draw and explain the waveform of the symmetrical short circuit armature current in synchronous machine. 7

6. (*a*) Explain the analysis of a short circuit on a loaded three phase synchronous machine. 7

(*b*) A synchronous generator and a synchronous motor each rated 25 MVA, 11 kV having 15% subtransient reactance are connected through transformers and a transmission line. The transformers are rated 25 MVA, 11/66 kV and

66/11 kV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25 MVA, 66 kV. The motor is drawing 15 MW at 0·8 power factor leading and a terminal voltage of 10·6 kV when a symmetrical three phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and fault. 7

7. Write short notes on the following:

(*i*) Excitation system control

(*ii*) Swing equation

(*iii*) Critical clearing angle. 14

8. (*a*) Explain the procedure for selection of circuit breakers in power system. 7

(*b*) Three 6·6 kV generators, A, B and C, each of 10% leakage reactance, 10% leakage reactance and MVA ratings 40, 50 and 25 respectively are interconnected electrically as shown in figure, by a tie bar through current limiting reactors, each of 12% reactance based upon the rating of the machine to which it is connected. A three phase feeder is supplied from the bus bar of generator A at a line voltage of 6·6 kV. The feeder has a resistance of 0·6 Ω/ph and an induction reactance

of 0·12 Ω/ph. Estimate the maximum MVA that can be fed into a symmetrical short circuit at the far end of the feeder. 7