

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 20016

B. Tech in Electrical Engineering, Semester VI

Roll No.....

COURSE: EE 602 Power System Analysis

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

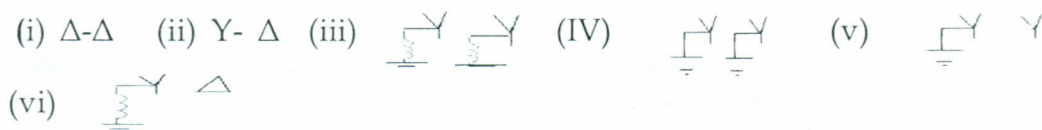
- Q.1 Objective type multiple choice questions (10 questions @ 1 mark) 10
- i. A 500 MVA, 11kV synchronous generator has 0.2 per unit synchronous reactance. The p.u. synchronous reactance on the base value of 100 MVA and 22 kV is:
(a) 0.16 pu (b) 0.01 pu (c) 4.0 pu (d) 0.25 pu
 - ii. When line to ground fault occurs, the current in a faulted phase is 100 A. The zero sequence current in this phase will be
(a) zero (b) 33.3 A (c) 66.6 A (d) 100 A
 - iii. The voltage source is un available in
a) positive sequence (b) negative sequence
c) zero & positive (d) zero & negative
 - iv. All sequence network are connected in parallel for the following fault
(a) SLG (b) LL
(c) LLG (d) 3-phase
 - v. The SLG fault current in the faulted phase is 300 A, the zero sequence current is
(a) zero (b) 300 A (c) 100 A (d) 66.6 A
 - vi. The current flowing through neutral impedance Z_n is
(a) I_{a1} (b) I_{a2} (c) I_{a0} (d) I_{a3}
 - vii. The real power depends on
(a) power factor (b) power angle
(c) power reactive (d) voltage
 - viii. Bus impedance matrix is used in study of
(a) load flow (b) power flow
(c) short circuit (d) none of the above
 - ix. The most common buses in a power system are
(a) slack bus (b) generator bus
(c) load bus (d) A&B
 - x. For a 15-bus power system with a 3-voltage controlled bus, the size of jacobian matrix is
(a) 11x11 (b) 12x12 (c) 24x24 (d) 25x25



- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- What are the need for slack bus?
 - Why do we use series reactors in the power system? Write its advantages.
 - List the assumption and restriction made for load flow solution.
 - Describe the different type of fault occurs in the power system.

Q.3A Explain the need of per unit method in power system calculation. Derived per unit impedance of transformer referred to primary side same as per unit impedance referred to secondary side. 05

Q.3B Draw a general diagram which can be used to determine zero sequence network of a two winding transformer. Using this circuit, draw zero sequence network of 05



Q.4A Give reason: 05

- For a fault at generator terminals, a single line to ground fault is generally more severe than a 3-phase fault.
- For a fault on transmission line, a 3-phase fault is more severe than other faults.

Q.4B Discuss the short circuit on a synchronous machine and design the different model of synchronous machine. 05

Q.5A Develop the block diagram corresponding to speed changer, speed governor and the hydraulic valve actuator. 05

Q.5B Discuss steady state stability of a single machine connected to infinite bus system. 05

Q.6A Two synchronous generators operating in parallel supply a total load of 200 MW. 05
 The ratings of the machines 1 and 2 are 100 MW and 200 MW. Machines 1 and 2 have governor droop characteristic of 4% and 3% respectively, from no load to full load. Assume that at full load, machines run at rated speed and the system frequency is 50 Hz. Calculate the load taken by each machine and the operating frequency.

Q.6B Discuss how the equal area criteria can be employed for determine the critical clearing angle. 05

OR

- Q.6B A 200 MVA, 11 kV, 50 Hz, 4-pole turbo generator has a inertia constant of 6 MJ/MVA. 05
 (a) Find the stored energy in the rotor at synchronous speed.
 (b) The machine is operating at a load of 120 MW when the load is suddenly reduced to 160 MW. Neglect the losses.
 (c) The retardation calculated above is maintained for 5 cycle. Find the change in power angle and rotor speed at the end of this period.

- Q.7A Determine the symmetrical components of the three currents 05
 $I_a = 10 \angle 0^\circ$ Amp, $I_b = 10 \angle 230^\circ$ Amp and $I_c = 10 \angle 130^\circ$ Amp

- Q.7B Explain the F-D method for solution of load flow study. Write algorithm of it for 05
 solution of load flow problem.

OR

- Q.7B Explain the N-R method for solution of load flow study. Write algorithm of it for 05
 solution of load flow problem.

- Q.8A A 30 MVA, 13.8 KV, 3-phase generator has a sub transient reactance of 15%. The 05
 generator supplies 2 motors through a step-up transformer - transmission line - step-down transformer arrangement. The motors have rated inputs of 20 MVA and 10 MVA at 12.8 KV with 20% sub transient reactance each. The 3-phase transformers are rated at 35 / 115 KV-Y with 10 % leakage reactance. The line reactance is 80Δ MVA, 13.2 KV- ohms. Draw the equivalent per unit reactance diagram by selecting the generator ratings as base values in the generator circuit.

- Q.8B Figure 1 show a 4-bus power system. The shunt admittance at the bus are negligible. 10
 The line impedance are as under:

Line bus to bus	1-2	2-3	3-4	1-4
R(pu)	0.025	0.02	0.05	0.04
X(pu)	0.10	0.08	0.20	0.16

- (a) Assume that the line shown dashed from bus 1 to bus 3 is not present. Formulate the Y_{bus}
 (b) Which element of Y_{bus} obtained above are affected when the line from bus 1 to bus 3 is added? (The new line has no mutual coupling with lines) If pu impedance of this line is $0.1 + j0.4$, find the new Y_{bus} .

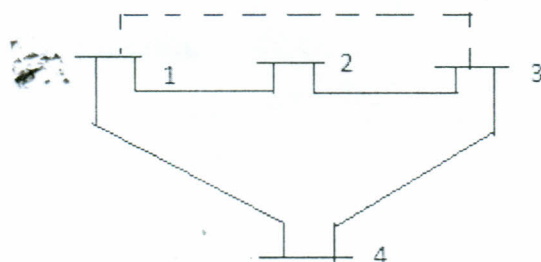


Figure 1

- Q.9 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 as shown in figure . 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.

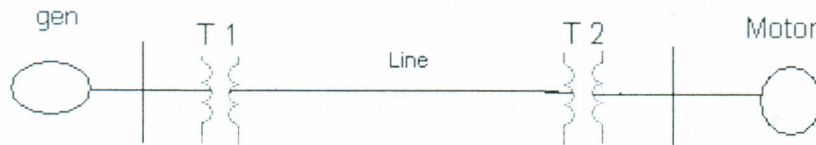


Figure 2

OR

- Q.9 Two 11KV, 20MVA, three-phase, star connected generators operate in parallel as shown in fig. The positive, negative and zero sequence reactance of each being, respectively $j0.18$, $j0.15$, $j0.10$ pu. The star point of one of the generator is isolated and that of the other is earthed through a 2.0 ohm resistor. A line to line fault occurs at the terminals of one of the generators. Estimate:

- a. The fault current, (b) Current in grounding resistor, and (c) The voltage across grounding resistor.

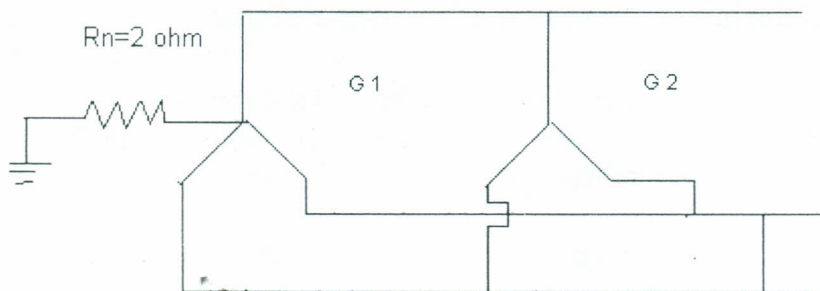


Figure 3