Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

I SEMESTER M.TECH (ENERGY SYSTEMS & MANAGEMENT)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: POWER SYSTEM OPERATION & CONTROL [ELE 5102]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 29 November 2016** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Use of non-programmable scientific calculator is permitted.

1A. The single-line diagram of an unloaded power system is shown in Fig 1A. The data of the generators and transformers are given below:

Equipment	MVA Rating	Voltage Rating (Line) kV	Reactance (p.u)
Generator 1	20	6.9	0.2
Generator 2	10	6.9	0.15
Generator 3	30	13.8	0.2
Transformer T_1	25	6.9 Δ / 115 Y	0.1
Transformer T_2	15	6.9 Δ / 115 Y	0.1
Transformer T_3 (for each single phase unit)	10	66.4 / 7.97	0.1

Transformer T_3 is a three phase bank made of three Single Phase Transformers. Draw the per unit reactance diagram considering 30 MVA as Base MVA. ***(07)***

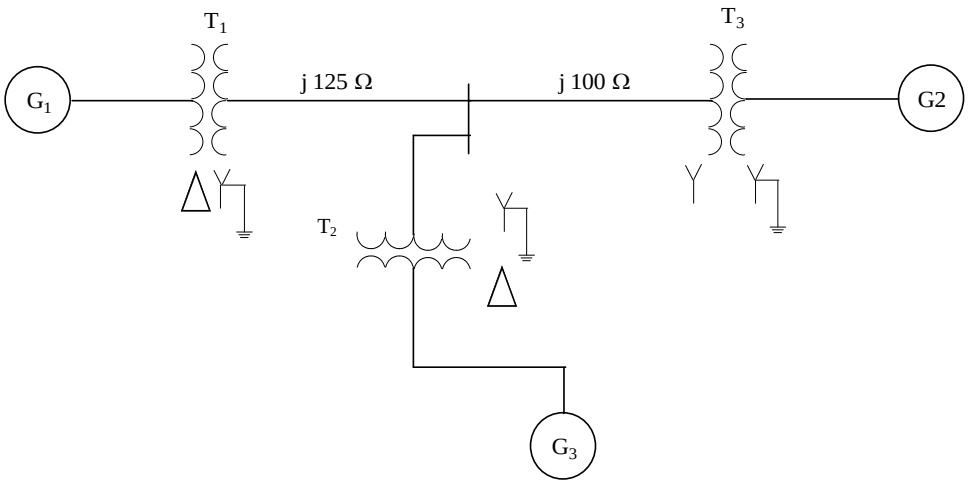

Fig. 1A

1B. A set of unbalanced currents are $I_a = 2\angle 45°$, $I_b = 1\angle 160°$ and $I_c = 0.9\angle 130°$. Determine the symmetrical components. ***(03)***

2A. For the power system shown in Fig. 2A, find the voltage magnitude and phase angle of Bus 2 using Newton-Raphson method. Perform two iterations. Select 100MVA as the base. The line admittance given is also at 100 MVA base. ***(07)***

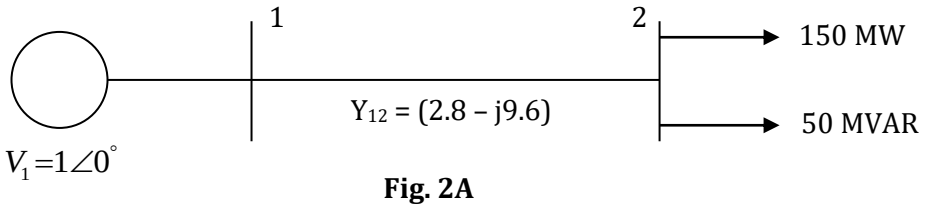

Fig. 2A

2B. A generator having a solidly grounded neutral and rated 50 MVA, 30 kV has positive, negative and zero-sequence reactances of 25, 15, 5 percent respectively. What reactance must be placed in the generator neutral to limit the fault current for a double line to ground fault to that of a three phase fault? ***(03)***

3A. A three phase alternator delivers a maximum power of 1.8 p.u to an infinite bus at 1.0 p.u through two transformers and two parallel transmission lines. The combined reactance from the alternator to the infinite bus is j0.65 p.u during steady state operation. A three phase symmetrical fault occurs at the middle of one of the transmission lines. The fault is cleared by simultaneously opening of the breakers at the end of the transmission line. If the combined reactance between the generator to infinite bus during fault and post fault are j1.8 p.u and 0.8 p.u respectively, Determine the critical clearing angle. ***(06)***

3B. Distinguish between steady state and transient stability and explain the factors effecting transient stability. ***(04)***

4A. With neat diagram explain the Load Frequency Control Loop for a Synchronous Generator. ***(07)***

4B. A synchronous machine is working under steady state condition. Determine v_d, v_q, i_d, and i_q, given $V_a = 1\angle 0°$, $I_a = 0.9\angle -30°$ p.u and $\delta = 30°$. ***(03)***

5A. Explain how the AC transmission lines can be compensated using shunt compensation. ***(06)***

5B. A three phase 60 Hz, 500kV, transmission line is 200 km long. The line inductance is 0.9 mH /km per phase and its capacitance is 0.015 μF / km per phase. If the receiving end rated load is 500 MW, power factor of 0.8 lag at 765 kV, Determine the sending end voltage. Assume a lossless line. ***(04)***