TECHNICAL UNVERSITY OF MOMBASA

Faculty of Engineering & Technology in Conjunction with Kenya Institute of Highways and Building Technology (KIHBT)

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

HIGHER DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

EEE 3206: POWER SYSTEMS IV

END OF SEMESTER EXAMINATION
SERIES: AUGUST 2014
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination

- *Answer Booklet*
- *A non-programmable Scientific Calculator*

This paper consists of **FIVE** questions. Answer any **THREE** questions
All questions carry equal marks

Maximum marks for each part of a question are as shown

This paper consists of **THREE** printed pages

Question One

a) (i) Differentiate between symmetrical and unsymmetrical faults.

(ii) Discuss the different types of line faults in power system. **(8 marks)**

b) Figure 1 shows a 3 phase, 5MVA, 6.6kV alternator with a reactance of 8% connected to a feed of series impedance (0.12 + j0.48) ohm/ph/km. The transformer is rated at 3MVA, 6.6kV/33kV and has a reactance of 5%. Determine the fault current supplied by the generator operating under on load with a voltage of 6.9kV, when a 3 phase symmetrical fault occurs at a point 15km along the feeder. **(12 marks)**

J0.8pv

Question Two

a) Derive an expression for the fault current for a single line-to-ground fault. **(5 marks)**

b) Show that in a delta-connected system, the zero-phase sequence voltage is absent in the line voltages. **(5 marks)**

c) A 3-phase star-connected alternator is rated 30MVA, 13.8kV and has the following sequence reactance valves: X1 = 0.25pu; X2 = 0.35pu and X0 = 0.10pu. The neutral of the alternator is solidly grounded. Determine the alternator line currents when a double lien to ground fault occurs on its terminals. Assume that the alternator is unloaded and is operating at rated voltage when the fault occurs. **(10 marks)**

Question Three

a) Explain with distinct examples the following terms with regard to power system:

(i) Steady state stability

(ii) Transient stability

(iii) Dynamic stability **(6 marks)**

b) Explain point by point method for solving the swing equation. **(4 marks)**

c) A transmission line is acting as a connection between two constant voltage networks. Determine graphically or otherwise, the maximum additional load that can be suddenly applied to such an interconnector already carrying 50mW if the power angle diagram is given by the equation.

$P = 100 \sin \alpha$ where P is the power transmitted in mW and α is the displacement between voltage phasors at the ends of the lines. **(10 marks)**

Question Four

a) A 3-phase synchronous generator with its neutral solidly grounded and operating at no load develops an L-a fault in one of the phases having fault impedance Zf. Derive expressions for the fault current and the line to-ground voltages at the location of the fault at all the phases. **(7 marks)**

b) A 14MVA, 13.2KV alternator has $X^{11} = X_2 = 20\%$ and $X_0 = 8\%$. The neutral of this machine is grounded through a reactance of 0.5 Ω. Compute initial symmetrical rms current in all the three phases of the machine when L-L fault occurs at its terminals under unloaded condition. The fault impendance is j0.1pu. Compute voltages at the terminals of the generator under faulted condition and express these voltages in the form of percentage of rated voltage. **(13 marks)**

Question Five

a) With the aid of diagrams, describe any THREE types of reactors in a power station stating ONE disadvantages of each connection. **(9 marks)**

b) Figure 2 shows a generating station feeding power to a 132kV system. Determine the total fault current, fault level and fault current supplied by each alternator for a 3-phase fault at the receiving end bus. The line is 200km long. **(12 marks)**

F_2