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UNIVERSITY EXAMINATIONS
2016/2017 ACADEMIC YEAR
REGULAR EXAMINATION

FOR THE DEGREE OF
BACHELOR OF EDUCATION
IN
TECHNOLOGY EDUCATION

COURSE CODE: ELT 461

COURSE TITLE: POWER SYSTEMS

DATE: 8TH DECEMBER 2016 TIME: 9.00 A.M – 12.00 NOON

INSTRUCTIONS TO CANDIDATES

- THIS EXAMINATION CONSISTS OF SEVEN QUESTIONS. FULL MARKS CAN BE
- "SCIENTIFIC" CALCULATOR
- MATHEMATICAL TABLES

THIS PAPER CONSISTS OF (4) PRINTED PAGES. PLEASE TURN OVER

1 (a) Identify and explain any two factors that must be considered before specifying type of generating station to be constructed.

(6 marks)

(b) Explain with the aid of a well labeled schematic diagram the steam cycle of a thermal steam generating station.-

(14 marks)

2 (a) what are the two main types of schemes of power factor correction. Why is it that power factor is rarely corrected to unity?

(6 marks)

(b) A consumer takes a load of 1500kW at 0.71 p.f. lagging and pays £10 per annum per Kva of maximum demand. Phase advancing plant costs £16 per kVAr to install. Determine the capacity of phase advancing plant required for minimum overall annual expenditure if interest and depreciation total 10%. Estimate the annual saying possible from installing phase advancing plant.

(14 marks)

3 (a) (i) State Kelvin's law.

(3 marks)

(ii) State any three limitations to the application of Kelvin's law.

(6 marks)

(b) A factory is to be supplied with electricity at 6.6 kV , three phase by a three conductor cable, the anticipated daily load being 800kVA for 8 hours, 300kVA for 8 hours and 100kVA for 8 hours for 250 days per year. Take the cost of wasted energy as 0.417p per kwh and the cost of copper as 29.6p/kg. one km of copper conductor of cross-section area 1cm^2 has a resistance of 0.177Ω and has a mass of 886kg. Allowing 12 per cent for interest and depreciation calculate the most economical cross-sectional area of each core.

(11marks)

4 . (a) Explain the electrical reactions holding a new machine in step with others in step after synchronizing.

(6 marks)

(b) A 6,600v 3- phase star-connected alternator has a synchronous impedance/phase of (0.4+j6) Ω. Determine the percentage regulation of the machine when supplying a load of 1000kW at normal voltage and power factor (i) 0.866 lagging, (ii) unity, (ii) 0.866 leading, giving complexor diagrams in each case.

(14 marks)

5. (a) Define the following terms,

(i) Stability limit
(ii) Steady- state stability
(iii) Transient stability

(6 marks)

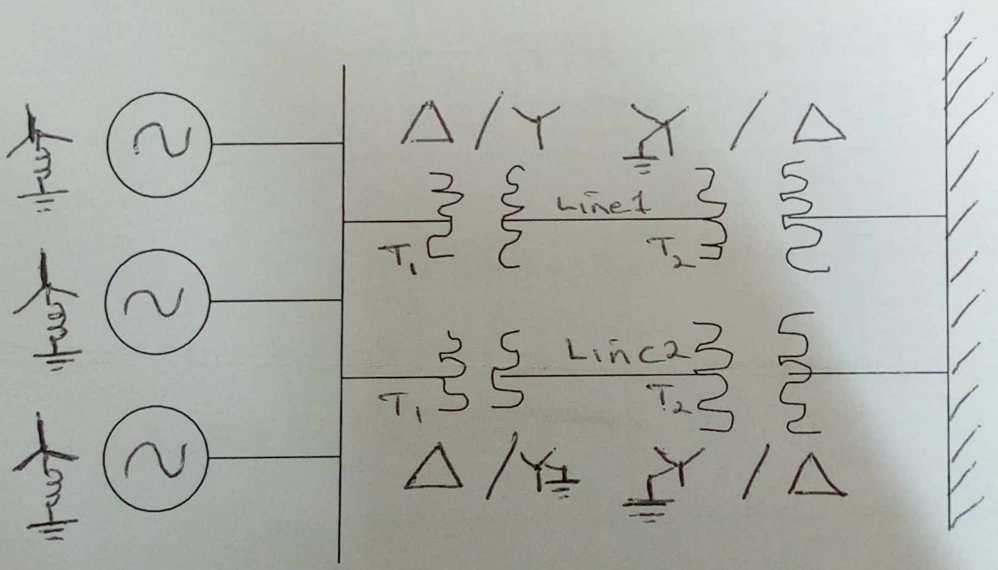
(b) A three-phase power system is represented by a synchronous machine connected to an infinite busbar by two parallel loss-free lines. The maximum power transfer values are

(i) 400 MW under healthy conditions with a double-circuit line,
(ii) 200 MW under healthy conditions with one line only,
(iii) 100 MW when system is faulted.

With a power transfer of 120 MW a fault occurs on the system. If the fault is cleared by switching out one line what is the critical clearing fault angle. Derive the expression used for this critical clearing angle of swing.

(14 marks)

6. A power system is shown below. Choosing as base values 45MVA and 33kv at the infinite busbars draw a single line diagram marking all reactance values in p.u. The power system delivers to the infinite busbar 45 MVA at 33kv and 0.8 p.f. lag. Calculate (i) The generator terminal voltage, (ii) the total MW and MVA, exported at the generator busbars. (iii) The load angle of each generator.

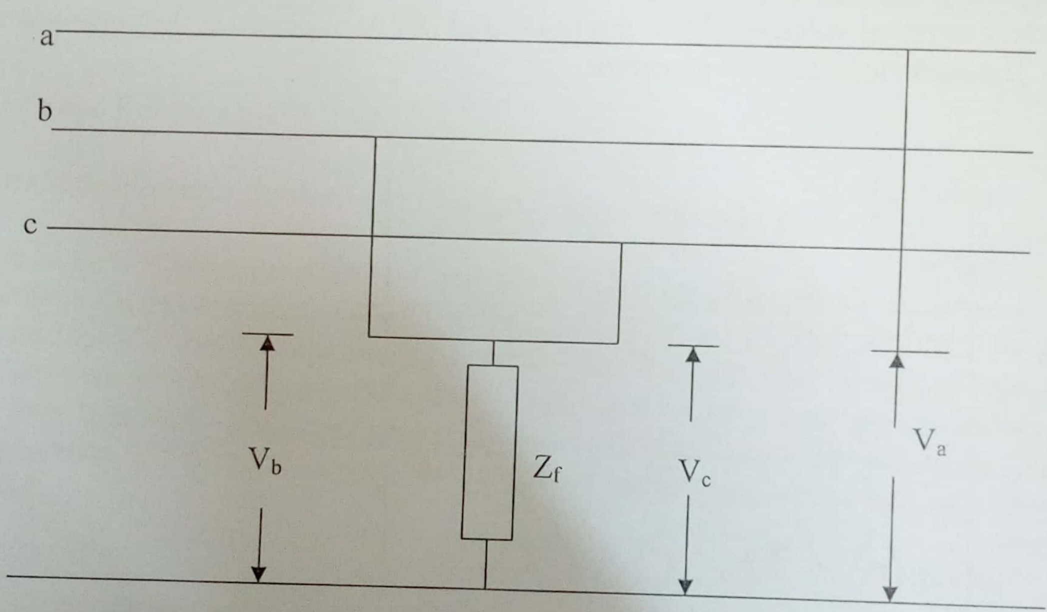


A.C. Generators: 3 identical, equally excited rated 20MVA, 20KV, X_s=20%

Transformers: T_1-75MVA, 20KV mesh/160KV star X=10%. T_2-75MVA, 160KV star/40KV mesh X=12%

Transmission lines- Line1:135 Ω reactance per line conductor. Line 2: 90 Ω reactance per line conductor.

7. The figure below represents a double line to ground fault. With the use of relevant equations determine the interconnection of the sequence networks for this type of fault.



(20 marks)