TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATIONS 2013/2014
FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

EEE 2312: ELECTRICAL MACHINES III

SUPPLEMENTARY/SPECIAL EXAMINATIONS
SERIES: FEBRUARY 2013
TIME: 2 HOURS

INSTRUCTIONS:

- You should have the following for this examination:
  - Answer booklet
  - Scientific calculator
  - Drawing instrument
- This paper consists of **FIVE** questions
- Answer any T**HREE**
- All questions carry equal marks

This paper consists of Three printed pages.

QUESTION 1

a) Explain conditions that takes place when a synchronous generator is short circuited at the terminals suddenly loaded. **(10 marks)**

b) A three phase 50MVA, 11KV, 60Hz salient pole synchronous machine has reactance X_d = 0.8p.v and Xq = 0.4PV. The synchronous motor is loaded to draw rated current at a supply power factor of 0.8 lagging. Rotational losses are 0.15P.V. 0.8 lagging. Rotational losses are 0.15P.V neglect armature resistance losses. Determine.

i) The excitation voltage E_f in P.V.

ii) The power due to field excitation and that due to saliency of the machine

iii) If the field current is reduced to zero will the machine stay in synchronism

iv) If the shaft load is removed before the field current is reduced to zero, determine the resultant supply current in p.v and the supply power factor. Draw the phasor diagram for the machine in this condition. **(20 marks)**

QUESTION 2

a) Explain the theory of **TWO** axes using the corresponding sketches. **(6 marks)**

b) Draw the electrical model for a salient machine and phasor diagrams for a motor with leading and lagging p.f. and a generator with leading and lagging p.f. **(8 marks)**

c) In a factory the following are the loads

- induction motors: 1000hp, 0.7 pf, 0.85% efficiency
- lighting and heating loads: 100kW

A 3-phase synchronous motor is to be installed to provide 300hp to a new process. The motor has efficiency of 92. Determine the KVA rating of the motor if the overall factory pf is to be raised to 0.95. Determine the pf of the motor. **(6 marks)**

QUESTION 3

a) With the aid of phasor diagrams explain the effect of speed change on an alternator. **(6 marks)**

b) i) State the **FOUR** necessary conditions for synchronizing an incoming machine to infinite Bus bar.

ii) Draw the corresponding phasor diagrams for each condition x in (i) commenting on the consequences if the conclusion is not met. **(14 marks)**

QUESTION 4

a) State **THREE** voltage regulation of a synchronous generator. **(8 marks)**

b) A 1500kVA, 6.6Kv, 3 phase, star-connected alternator has effective armature resistance of 0.5Ω /phase. Determine the percentage change in terminal voltage when the load is switched of at;

i) Unity pf

ii) 0.8 lagging pf

iii) 0.8 leading if

iv) Draw the phasor diagram for each condition. **(12 marks)**

c) Describe the difference between the synchronous impedance and Ampere turn method with respect to determination of voltage regulation. **(5 marks)**

QUESTION 5

a) State **FOUR** advantages of parallel operation of alternators. **(4 marks)**

b) With the aid of a relevant sketch and phasor diagram derive the synchronous power of an alternator. **(6 marks)**

c) Two 3-phase star connected 6.6KV alternatours supply a load of 3000kW at 0.8p.f lagging and share the load equally. The excitation of machine 2 is so adjusted that it supplies 150A at a lagging power factor. The per 2 are $(0.4 + j12)\ \Omega$ and $(0.5 + j10)\ \Omega$ respectively. Determine:

i) Current

ii) Power factor

iii) Induced emf

iv) Load angle of each machine **(10 marks)**