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University Examinations 2013/2014

THIRD YEAR, SECOND SEMESTER EXAMINATION FOR DIPLOMA IN ELECTRICAL ENGINEERING

EEE 0247: SYNCHORNOUS MACHINES II

DATE: APRIL 2014 **TIME: 1 ½ HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE – (30 MARKS)

(a) Define the term 'Synchronous machine' (1 Marks)
(b) Explain the functions of the following parts of a synchronous machine
  (i) Rotor (2 Marks)
  (ii) Stator (2 Marks)
(c) Differentiate between synchronous generator and synchronous compensator. (2 Marks)
(d) Explain three types of turbines used with synchronous generators. (2 Marks)
(e) Explain the purpose of exciting an alternator. (2 Marks)
(f) With aid of a well labelled diagram explain any method of excitation. (4 Marks)
(g) Differentiate the following four types of winding.
  (i) Concentrated winding
  (ii) Distributed winding
  (iii) Full pitch winding
  (iv) Short pitch winding (4 Marks)
(h) Define the term voltage regulation as used with synchronous generators. (2 Marks)
(i) Explain three conditions that must be met before connecting a generator to the bus bars. (3 Marks)
(j) State three factors that contribute to reduction in terminal voltage when a generator is on load. (3 Marks)

QUESTION TWO – (15 MARKS)

(a) The stator winding of a synchronous machine has 48 slots. A 4 pole winding is made on the stator. If each coil spans 11 slots, calculate the pitch factor. (3 Marks)

(b) A three phase, star connected synchronous generator on open circuit is required to generate a live voltage of 3600V, 50HZ when driven at 500rpm. The stator has 3 slots/pole/phase if the winding is full pitch calculate:

(i) Number of poles (2 Marks)

(ii) Useful flux per pole (6 Marks)

(c) With aid of diagrams distinguish between salient pole rotor and cylindrical pole rotor. (4 Marks)

QUESTION THREE – (15 MARKS)

(a) Discuss the following tests carried out on a synchronous generator

(i) Open circuit test (4 Marks)

(ii) Short-circuit test (4 Marks)

(b) A 1200KVA, 3300V, 50HZ three phase, star connected alternator has an Ra of 0.4Ω per phase. A field current of 40A produces a short circuit current of 200A, and an open circuit emf of 1100V (line). Calculate the voltage regulation on full load at a p.f of 0.85 lagging. (7 Marks)

QUESTION FOUR – (15 MARKS)

(a) A 10,000KVA, 3Ø, star connected, 11000V, 2 pole, turbo-generator has a synchronous impedance of (0.0145 + j0.5)Ω per phase. The various losses in this generator are as follows:

- Open circuit core loss at 11000V = 90KW
- Windage and friction loss = 50KW
- Short circuited load loss at 525A = 220KW
- Field winding resistance = 3Ω
- Field current = 175A

Determine the efficiency at

(i) Full load at 0.8p.f leading (4 Marks)

(ii) Half load at 0.9pf lagging (4 Marks)

(b) A 3Ø, 16 pole, star connected alternator has 144 slots and 6 conduction per slot. The flux per pole is 30mWb sinusoidally distributed, and speed is 375rpm. If the coil span is 160^0, Determine;

(i) Frequency (1 Mark)

(ii) Pitch factor (2 Marks)

(iii) Distribution factor (2 Marks)

(iv) Phase e.m.f (1 Mark)

(v) Line e.m.f (1 Mark)