

MOI UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

THIRD YEAR,SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF

**BACHELOR OF ENGINEERING
IN
ELECTRICAL & COMMUNICATIONS ENGINEERING**

COURSE CODE: ECE 362

COURSE TITLE: ELECTRICAL MACHINES II

TIME: 3 HRS

INSTRUCTIONS TO CANDIDATES

ATTEMPT ANY FIVE OF THE FOLLOWING SEVEN QUESTIONS.

QUESTION ONE

1(a) Explain **any three** advantages of having stationary armature and rotating field system in a synchronous generators? **(6 MRKS)**

(b)(i) Define the terms *pitch factor* (k_c) and *distribution factor* (k_d) as applied to the armature windings of an alternator. **(2 MRKS)**

(ii) Find the value of k_d for an alternator with 9 slots per pole for the following cases: one winding in all the slots, one winding using only the first 2/3 of the slots per pole and three equal windings placed sequentially in 60° group. **(3 MRKS)**

(c) What are the advantages of the using salient pole rotor over cylindrical rotor in alternators. **(3 MRKS)**

QUESTION TWO

2(a) Derive from the first principles the equation of induced E.M.F in armature windings of an alternator. **(5 MRKS)**

(b) A 60-Kva 220V, 50-Hz single phase alternator has effective armature resistance of 0.016Ω and an armature leakage reactance of 0.07Ω . Calculate the voltage induced in the armature when the alternator is delivering rated current at a load power factor of;

- (i) Unity
- (ii) 0.7 lagging
- (iii) 0.7 leading

(6 MRKS)

(c) Give **three** advantages of using fractional-pitch coils in the armature of an alternator. **(3 MRKS)**

QUESTION THREE

3(a)(i) What are the causes of changes in voltage in Alternators when loaded? **(3 MRKS)**

(ii) What is armature reaction in alternators. Clearly draw the phasor diagram of an alternator depicting the effect of armature reaction when the power factor of the load is leading. **(2 MRKS)**

(b) The open and short-circuit test readings for a 3-phase, star-connected, 1000-kva, 2000v, 50Hz, alternator are as below:

Field Amps	10	20	25	30	40	50
O.C Terminal V	800	1500	1760	2000	2400	3800
S.C Armature current (A)		250	300	360		

The effective armature resistance is 0.2Ω per phase. Draw the characteristic curves and estimate the full-load percentage regulation using Ampere-turn method at 0.8 p.f lagging and 0.8 p.f leading. **(9 MRKS)**

QUESTION FOUR

4(a)(i) What is *an infinite bus-bar*? **(1 MRKS)**

(ii) Outline the conditions to be met before an alternator is connected to grid. **(3 MRKS)**

(b)(i) With the help of vector diagrams give a detailed outline on how two alternators can be synchronized using the three lamps method. **(8 MRKS)**

(ii) Give **two** disadvantages of using the three-lamps method. **(2 MRKS)**

QUESTION FIVE

5(a) With the help of a clearly drawn and labeled phasor diagram derive an expression of the power developed by a salient pole synchronous generator. **(6 MRKS)**

(b) A synchronous motor absorbing 60Kw is connected in parallel with a factory load of 240Kw having a lagging power factor of 0.8. If the combined load has a p.f of 0.9, what is the value of the leading Kvar supplied by the motor and what p.f is it working? **(4 MRKS)**

(c) Briefly describe the procedure used in starting a synchronous motor. **(4 MRKS)**

QUESTION SIX

a) A three phase 600 MVA generator has rated terminal voltage of 22 kV(line). The stator winding is star-connected and has resistance of 0.014Ω /phase and synchronous impedance of 0.16Ω /phase. Calculate the voltage regulation for a load having a p.f;

(i) unity (ii) 0.8 lagging. **(8 MRKS)**

(b) Draw phasor diagrams for synchronous motor with no losses when its under-excited, overexcited and normally excited. **(6 MRKS)**

QUESTION SEVEN

7 (a) A 200-hp, 2300-V, three-phase, 60-HZ, cylindrical-rotor motor has a synchronous reactance of 12Ω per phase and negligible armature resistance. When it is delivering its rated output, the motor's efficiency is 90% and its power angle δ is 17° . Determine

(i) The excitation voltage E_a
 (ii) The stator current I_a and power factor. Draw phasor diagram. **(5 MRKS)**

(b) A 3 phase wye connected synchronous generator supplies current of 10 A having phase angle of 20° lagging at 400V. Find the load angle and the components of armature current (d-axis and q-axis) if $X_d = 10\Omega$ and $X_q = 6.5\Omega$. Assume armature resistance to be negligible. **(4MRKS)**

(c) Give a brief comparison between synchronous motors and induction motors. **(5 MRKS)**