



MUEO

MOI UNIVERSITY

OFFICE OF THE CHIEF ACADEMIC OFFICER

UNIVERSITY EXAMINATIONS
2011/2012 ACADEMIC YEAR
THIRD YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE OF
BACHELOR OF TECHNOLOGY**

**IN
ELECTRICAL AND COMPUTER
ENGINEERING**

COURSE CODE: ECE 362

COURSE TITLE: ELECTRICAL MACHINES II

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES

➤ ATTEMPT ANY FIVE OF THE FOLLOWING SEVEN QUESTIONS
THIS PAPER CONSISTS OF (3) PRINTED PAGES PLEASE TURN OVER

QUESTION ONE

1(a) Explain the 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 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) What are the 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	2600
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

5a) 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 diagram for synchronous motor with no losses when its under-excited, overexcited and normally excited.

(6 mrks)

QUESTION SIX

6(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 60 Kw is connected in parallel with a factory load of 240 Kw 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 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.

(4 mrks)

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

(5 mrks)