



**MOI UNIVERSITY**

OFFICE OF THE CHIEF ACADEMIC OFFICER

**UNIVERSITY EXAMINATIONS  
2012/2013 ACADEMIC YEAR  
SUPPLEMENTARY EXAMINATIONS**

**FOR THE DEGREE OF  
BACHELOR OF TECHNOLOGY**

**IN  
ELECTRICAL AND COMPUTER  
ENGINEERING**

**COURSE CODE:** ECE 362

TIME:3 HRS

**COURSE TITLE:** ELECTRICAL MACHINES II

**DATE:**

**TIME:**

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*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  $60^\circ$  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  $0.016\Omega$  and an armature leakage reactance of  $0.07\Omega$ . 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  $0.2\Omega$  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) 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 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  $0.014\Omega$ /phase and synchronous impedance of  $0.16\Omega$ /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) (a) With the help of **neat** sketches explain the principle behind the working of shaded-pole motor. **(8 mrks)**
- (b) In what direction does a shaded pole motor rotate? **(2 mrks)**
- (c) State which single phase motor is the most suitable for the applications;
- (i) Planing machine  
(ii) Vacuum cleaner  
(iii) Cooling fans  
(iv) Small fans **(4 mrks)**

#### **QUESTION SEVEN**

- 7(a) (i) Using double-field rotating theory explain why are single phase motors not self starting? **(5 mrks)**
- (ii) How are single phase motors made self starting? **(3 mrks)**
- (b) With the aid of a diagram describe the principle of operation of split-phase induction motor. **(4 mrks)**
- (c) State *any* two areas of applications of split-phase motor. **(2 mrks)**