KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 214: ELECTRICAL ENGINEERING II

DATE: TUESDAY, 17TH APRIL 2012 **TIME: 4.30 P.M. – 6.30 P.M.**

INSTRUCTIONS:

Question ONE is COMPULSORY

Answer any other TWO questions.

QUESTION ONE

a) Explain with appropriate diagrams how armature reaction effect is corrected in DC machines.

(8 marks)

b) A six pole wave wound shunt generator has a field resistance of 60 Ohm. When the generator delivers 60kW the terminal voltage is 120V while the generated EMF is 133V. Draw the circuit model for the shunt generator. Determine:

i) the armature resistance

ii) the generated EMF and speed ***n*** (rev/min) when the output is 20kW and the terminal voltage 135 V given that the number of armature conductors is 200 and the flux per pole is 20mwb.

(12 marks)

c) An iron ring has a mean diameter of 15cm, a cross sectional area of $20cm^2$ and a radial gap of 15mm cut in it. It is uniformly wound with 1500 turns of insulated wire and a magnetizing current of 1A produces a flux of 1mwb. Neglecting the effect of magnetic leakage and fringing, calculate:

a) the reluctance of the magnetic circuit

b) relative permeability of iron.

(10 marks)

QUESTION TWO

a) With the aid of a well labelled diagram explain how a DC motor manual starter operates.

(10 marks)

b) A mining drill is driven by a shunt DC motor. The motor is rated at 240V and runs at 1000 rev/min at no load. It is required to increase the speed of the drill to 1250rpm while drawing an armature current of 40A. The armature resistance and field resistance are 0.25 and 150 Ω respectively. Determine the resistance to be placed in series with the field so that the motor runs at this new speed. Assume the pole flux to be proportional to the field current and neglect rotational losses.

(10 marks)

QUESTION THREE

a) By aid of a diagram explain the auto transformer method of starting of a three phase induction motor.

(6 marks)

b) A three phase 220V 50Hz six pole induction motor has the following data from the manufactures nameplate readings on per phase basis:

Rs=0.14Ω

Xs=0.298Ω

Rr`=0.15Ω

Xr`=0.25Ω

Xm=13.6Ω

The rotor parameters have been referred to the stator. The rotational losses and cores losses combined amount to 402W and are constant. For a slip of 5.8% determine:

(i) The line current and power factor

(ii) The shaft torque and output power

(iii) The efficiency of the motor.

(14 marks)

QUESTION FOUR

a) Describe how a three phase synchronous operates.

(5 marks)

b) A 440V three phase star connected synchronous motor has a synchronous reactance Xs=2.1Ω per phase. The field excitation is adjusted such that the counter e.m.f. generated is 402V. If the input power amounts to 45kW and assuming negligible armature resistance, determine the line current, torque angle and the power factor at which the machine is operating. Sketch the appropriate phasor diagram.

(15 marks)

QUESTION FIVE

a) Explain the short circuit test and derive the parameters that can be determined from it.

(5 marks)

b) A company transformer rated at 100 kVA, 3300/240 V transformer is tested on the open circuit and short circuit with the results displayed on the table below:

Test	Primary voltage, V_1, v	Primary current, I_1, A	Primary power, P_1, w
Open circuit	3300	0.8	400
Short circuit	224	16	600

Calculate for a lagging power factor of 0.85

(i) the efficiency at full load

(ii) the efficiency at 35% of full load

(iii) the voltage regulation

(iv) the terminal secondary voltage

(v) the transformer parameters

(15 marks)

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