Kafrelsheikh University
Faculty of Engineering
Subject: **Special machines**
Year: Fourth Electrical power (R. 2007)
Exam Date: 9/6/2021

Final Exam of 2nd semester-2020-2021
Department of Electrical Engineering
course code: EPM4227 Full Mark: 90 Marks
number of pages: 2 Time allowed: 3 hours

This exam measure the following LOs (a1, a2, b2, b3, b4, c1, c2)

Attempt all question, Assume any missing data

Q1: (25 Mark)

(i) How the equivalent circuit parameters are obtained for an induction motor? [10 Marks]

(ii) A universal motor give the following tests:

DC test $I_a = 2$ A, $V_f = 16$ V, $V_a = 10$ V, $E_a/\omega_r = 0.34$ V.sec./rad

AC test $I_a = 2$ A, $V_f = 110$ V, $V_a = 20$ V, $E_a/\omega_r = 0.28$ V.sec./rad

In case motor current is 2 A at 220 V, estimate the motor speed and torque when is energized from (*i*) dc source, and (*ii*) ac source. [10 Mark]

(iii) Explain the deference between concentrated pole and distributed field types of universal motor. [5 Mark]

Q2: (25 Mark)

a) What are the Advantages and disadvantages of Repulsion Motor? [10 Marks]

b) A three-phase, variable reluctance stepper motor has a phase winding resistance and average inductance of 1 Ω and 30 mH, respectively. The phase winding rated current is desired to be 3 A. Design a uni-polar drive circuit for this motor with a net ON Mode and OFF Mode circuit time constants of 2 *msec* and 1 *msec*, respectively. Assume that the stepping rate is 300 steps per second.

[15 Mark]

Q3: (20 Mark)

a) Explain the different types of the drive circuit of stepper motor? [5 Mark]

b) What are the servo motor requirements? [5 Mark]

c) A ¼-hP, 110-V, 60-Hz, four-pole, capacitor-start motor has the following equivalent circuit parameter values and losses:

$R_{1,main} = 2.02\ \Omega$, $X_{1,main} = 2.79\ \Omega$, $R_{2,main} = 4.12\ \Omega$, $X_{2,main} = 2.12\ \Omega$, $X_{m,main} = 66.8\ \Omega$. Core loss = 24 W, Friction and windage loss = 13 W,

For a slip of 0.05, determine the stator current, power factor, power output, speed, torque, and efficiency when this motor is running as a single-phase motor at rated voltage and frequency with its starting winding open. [10 Mark]

Q4: (20 Mark)

a- Drives the resultant torque of brushless dc motor when operate from ac source; draw the torque waveform of 3 phases PLDC.

[10 Mark]

b- Explain the nature of torque production of switched reluctance motor.

[10 Mark]

With my best wishes

Associate Prof./Mohamed I. Abd EL_Wanis