UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	ELECTRICAL MACHINES
COURSE CODE	:	DAR 21803
PROGRAMME CODE	:	DAR
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) State and briefly describe the emf generated equation of the various self excited DC machines

(i) series DC machines
(ii) shunt DC machines
(iii) compound DC machines

(12 marks)

(b) A DC shunt generator delivers 22 kW at a terminal voltage of 210 V when driven at 1500 rpm. The armature, shunt field and series field resistances are 0.05 Ω, 110 Ω and 0.06 Ω respectively. If the overall efficiency at this load is 86%, calculate

(i) the copper loss.
(ii) the iron loss.

(13 marks)

Q2 (a) With the help of diagram describe the torque speed characteristic of the following dc machines:

(i) DC Series Motor
(ii) DC Shunt Motor
(iii) DC Compound Motor

(6 marks)

(b) A compound DC motor rated at 415 V, 10 HP, 1500 rpm has armature resistance 0.35 Ω, series field resistance 0.65 Ω and shunt field resistance 80 Ω. The rotational losses are 500 W. The full load line current is 40 A. Draw the schematic diagram and calculate:

(i) Input power
(ii) Developed mechanical power
(iii) output power
(iv) Load torque
(v) Developed torque
(vi) Efficiency of the motor

(19 marks)

Q3 (a) A transformer is rated 75kVA, 7200/240V. A load having an impedance of 1.0Ω is connected to the secondary.

(i) Find the current on each side of the transformer.

(ii) Calculate the power delivered to the load.

(iii) Determine the input impedance on the primary side.

(9 marks)

(b) Short-circuit and open-circuit tests were performed on a 80kVA transformer, 50 Hz, rated at 7000V/240V, and the results are listed as follows:

Open circuit test

Primary open circuited with instrumentation on the low voltage side

$V_{oc} = 240$ V
$I_{oc} = 12$ A
$P_{oc} = 1000$ W

Short circuit test

Secondary short circuited with instrumentation on the high voltage side

$V_{sc} = 400$ V
$I_{sc} = 11.43$ A
$P_{sc} = 1800$ W

Determine necessary parameters and draw the equivalent circuit of the transformer referred to the low voltage side.

(16 marks)

Q4 A 3-phase induction motor, delta connection,5 pair of poles, 60 Hz is connected to a 440V source. The slip is 3% and the windage and friction losses are 3kW. The equivalent circuit per phase referred to the stator circuit is:-

R_1	= Stator resistance	= 0.4Ω
X_1	= Stator leakage inductance	= 1.4Ω
R_2	= Rotor resistance	= 0.6Ω
X_2	= Rotor leakage inductance	= 2Ω
R_m	= no-load loses resistance	= 150Ω
X_m	= magnetizing reactance	= 20Ω

Calculate:
(i) Input power
(ii) Speed of the rotor
(iii) Mechanical power
(iv) Developed torque
(v) Efficiency

(25 marks)

Q5 A 3-phase Y-connected synchronous generator supplies a load of 10MW at power factor 0.85 lagging and the terminal voltage is 11kV. The armature resistance is 0.1 ohm/phase and synchronous reactance of 0.66 ohm/phase. Calculate :
(i) the armature current
(ii) the internal generated voltage
(iii) the voltage regulation.

(21 marks)

Draw the phasor diagram showing the relation of the internal generated voltage, the output voltage and the armature current.

(4 marks)

Q6 (a) Explain the following aspect of a motor and a generator:

(i) basics principals of operation
(ii) two of the basic units/parts of these machines
(iii) the purpose of the nameplate given for the machines

(9 marks)

(b) In order to evaluate the performance an asynchronous machines under steady and dynamic condition three type of test are carried out upon the machines. Describe the aims and the purposes of the test.

(10 marks)

(c) Electrical and mechanical faults can impose unacceptable conditions and protective devices are therefore provided to quickly disconnect the machines from the grid/supply. Thus in order to ensure that electrical machines receive adequate protection routine test and type test are performed to verify the quality of the assembly. Describe the various analysis carried out by the routine test programmed and the type test programmed.

(6 marks)

-END OF QUESTIONS-