UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : MECHANICAL*
SUBJECT	:	**ELECTROTECHNOLOGY III**
CODE	:	**ELT 312**
DATE	:	YEAR END EXAMINATION 30th NOVEMBER 2016
DURATION	:	08:30 - 11:30
WEIGHT	:	40 :60
FULL MARKS	:	100
TOTAL MARKS	:	103

EXAMINER	:	MR A.F. COTTRELL
MODERATOR	:	PROF. A.A. YUSUFF
NUMBER OF PAGES	:	5 PAGES (INCLUDING COVER PAGE)

INSTRUCTIONS	:	CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)

INSTRUCTIONS TO STUDENTS:

1. ANSWER ALL QUESTIONS.
2. RULE OFF AFTER EVERY QUESTION OR SUB-QUESTION.
3. DO NOT ANSWER A QUESTION OR PART THEREOF TWICE. CROSS OUT WHAT YOU DO NOT WANT MARKED.

SECTION A D.C. MACHINES

QUESTION 1

1.1 Discuss "Armature Reaction". Give definition, and use diagrams to explain. (12)

1.2 Explain why the speed of a shunt-wound D.C. motor is almost constant between no load & full load. Also state your assumptions. (5)

[17]

QUESTION 2

A 320-volt series motor draws 144 ampere and runs at a speed of 850 r/min., under certain load conditions. If the armature and series field winding resistances are 0.13 Ω and 0.07 Ω, respectively, calculate:

2.1 The e.m.f. under these initial conditions. (3)

2.2 The copper loss in the armature, and the series field. (3)

2.3 If the iron and mechanical losses amount to 2.78 kW, what is the electrical output power? (4)

2.4 The shaft torque. (2)

[12]

SECTION B TRANSFORMERS

QUESTION 3

3.1 Why is the core of a power frequency transformer (i.e., 50-Hz) laminated? (4)

3.2 What is the meaning of the "%Z" designation, on the nameplate of a transformer? (3)

3.3 If you found the following information on the nameplate of a single phase transformer:

kVA rating:	120 kVA
V_1:	6500 V
V_2:	1100 V
%Z:	6.74%

Determine the equivalent impedance of this transformer, referred to the high voltage (H.V.) side. (5)

[13]

QUESTION 4

The open circuit and short circuit tests were carried out on a 50 kVA, 550/115 volt, 50-Hz, single phase transformer, yielding the following results:

Open Circuit Test			Short Circuit Test	
Applied voltage	550 volt		Applied voltage	30 volt
O.C. volts	115 volt		Primary current	76 amps
No load current	2.8 ampere		Secondary current	362 amps
No load power	564 watt		Wattmeter reading	521 watt

Table Q4

From the results in Table Q4, determine:

4.1 Was the short circuit test carried out at rated full load currents? (3)

4.2 What is the percentage impedance of this transformer? (3)

4.3 What is the full load copper loss? (2)

4.4 Calculate the per unit voltage regulation and secondary terminal voltage on no load, if the load power factor is:

4.4.1 0.8 lagging. (5)

4.4.2 0.7 leading. (3)

4.5 The efficiency of this transformer on full load, at a power factor of 0.8 lagging. (2)

4.6 The fraction of full load, "n", at which maximum efficiency takes place. Also calculate the value of this efficiency. (3)

4.7 The equivalent series impedance, referred to the low voltage (l.v.) side. (3)

[24]

SECTION C 3-PHASE INDUCTION MOTORS

QUESTION 5

5.1 " "Slip" is a fundamental characteristic of an induction motor" – Discuss. (6)

5.2 Explain why the rotor iron loss is normally neglected in the power flow diagram of an induction motor. (3)

[9]

QUESTION 6

A certain catalogue, giving specifications of 3-phase induction motors, gives the following information:

Rated power	45 kW
Rated speed	2960 r/min
Efficiency	92.5%
Power factor	0.83
Rated voltage	400 V

Use this information to determine:

6.1 The phase current if the stator is delta connected. (3)

6.2 If the motor is started, using "Direct-on-line" starting, what would you expect the starting (line) current to be? (3)

6.3 What is the rated slip? (3)

6.4 Calculate the output torque, at the shaft. (2)

6.5 If the mechanical losses amount to 730 W, what is the rotor copper loss? (3)

6.7 Find the total stator loss. (3)

[17]

SECTION D SYNCHRONOUS MACHINES

QUESTION 7

7.1 If a synchronous generator is running on it's own, the power factor at which it operates is dependent upon _____, but if it is synchronised onto an infinite bus, its power factor depends on _____. (Fill in the missing words in your answer script). (4)

7.2 A 150 kVA, 420 V, 3-phase synchronous generator has a synchronous impedance of $(0.2 + j1.1)\ \Omega$/phase. If it operates at full load at a power factor of 0.87 lagging, determine:

7.2.1 The rated full load current. (2)

7.2.2 The e.m.f. and load angle. (3)

7.2.3 If the e.m.f. and load angle change to 231 volt and 58^{o}, respectively calculate the new power factor. Assume the current remains constant at full load value. (3)

[12]

TOTAL: **[103]**