UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : MECHANICAL*
SUBJECT	:	**ELECTROTECHNOLOGY III**
CODE	:	**ELT 312**
DATE	:	SUMMER EXAMINATION 2015 9 NOVEMBER 2015
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40 :60
FULL MARKS	:	100
TOTAL MARKS	:	100

EXAMINER	:	MR A.F. COTTRELL	80825003
MODERATOR	:	MS. C. MAMPANE	2043
NUMBER OF PAGES	:	4 PAGES	

INSTRUCTIONS	:	CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)

REQUIREMENTS	:	NONE.

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.

QUESTION 1

1.1 Derive the torque equation of a D.C. machine. (7)

1.2 Sketch the torque curves for both the shunt & series motors, explaining the curve shapes. (8)

1.3 A shunt machine has armature and field resistances of 0,12 Ω and 120 Ω respectively. When connected to a 450 V d.c. supply and driven as a generator at 940 rev/min, it delivers 200 kW. Calculate its speed when running as a motor and taking 50 kW from the same supply. (16)

[31]

QUESTION 2

2.1 The following data were obtained during tests on a 150kVA, 1100/420V single phase transformer:

Open Circuit Test	1.1 kV	3.1 A	745 W
Short Circuit Test	40V	110A	880 W (measured on the HV side)

If a given load has a power factor of 0.8, lagging, calculate:

3.1.1 Efficiency at full load (6)

3.1.2 I^2R losses at half load (2)

3.1.3 The load kVA at which maximum efficiency will occur . Is this result reasonable in your opinion? Explain. (2)

3.1.4 The magnetizing current (4)

3.1.5 The equivalent series resistance referred to the LV-side (5)

3.1.6 The equivalent series reactance referred to the HV-side (2)

2.2 Draw the full equivalent circuit of a single-phase transformer, including all the voltages and currents. (9)

[30]

QUESTION 3

3.1 In Annexure A, Figure 1(a) shows one cycle of three phase currents, marked at points A, B, C, and D.
Figure 1 (b) illustrates four cross-sections of the Stator and Rotor of the same 3-phase, two – pole, induction motor. The beginning of each winding is marked "Red", Yellow" & "Blue", respectively. Fill in the currents flowing, and the flux lines due to the said currents, and thus, show how three phase currents produce a rotating magnetic field, in a 3-phase induction motor. (8)

3.2 The power ***input*** to a 4-pole, 400-volt, 50Hz, 3-phase induction motor is **55** kW. The stator losses total 1.2 kW. If the full load slip is 2.6% , sketch the power flow diagram, and calculate: (7)

3.2.1 the Gross mechanical power developed (4)
3.2.2 the full load output torque at the shaft, if the mechanical losses amount to 700 watt. (6)

3.3 The e.m.f. measured between slip rings on the star connected rotor of a 3-phase, slip ring induction motor is 110 V at standstill. The rotor impedance at standstill, is (0,2 + j0,55) Ω/phase and the full load slip is 4%
Calculate at full load:

3.3.1 the rotor current. (3)
3.3.2 the rotor power factor (2)

[30]

QUESTION 4

4.1 A three-phase, star-connected, 2200-volt, 50 Hz alternator has a synchronous impedance of (1 + j5) Ω/phase. If it has an output of 180 kVA at a power factor of 0.8 lagging, calculate the e.m.f. and load angle. Sketch the phasor diagram for this condition.

[9]

TOTAL **[100]**

ANNEXURE A (TO BE HANDED IN, WITH ANSWER BOOK)

NAME:_____

STUDENT NUMBER:_____

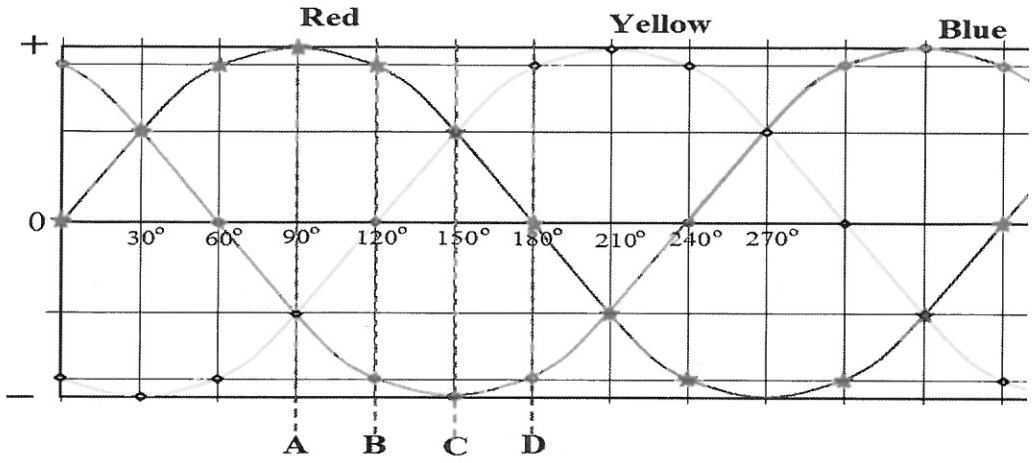

Figure 1 (b)
Three phase currents

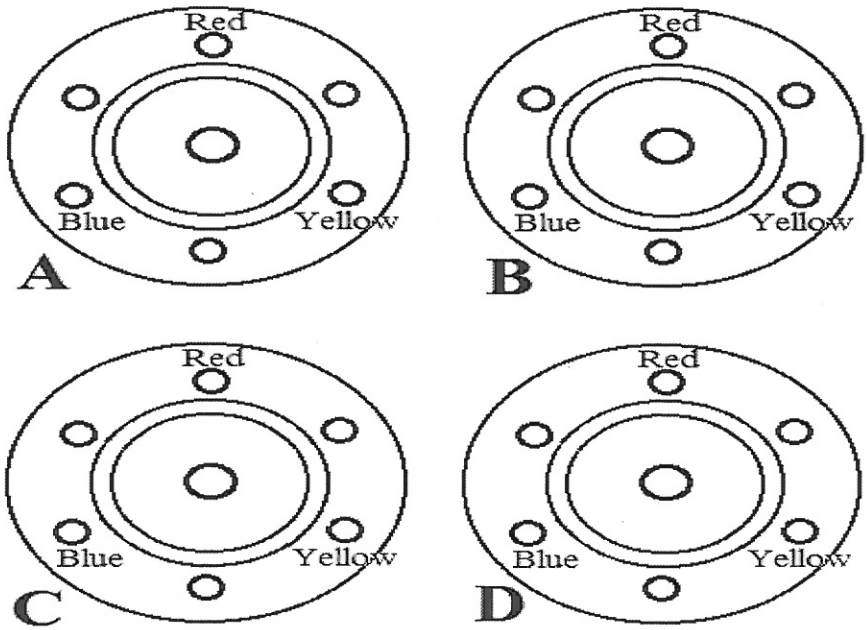

Figure 1 (a)
Cross sectional view of a three-phase, two-pole induction motor.