UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: ELECTRICAL*
SUBJECT	:	**ELECTRICAL MACHINES II**
CODE	:	**ELM2221**
DATE	:	SUPPLEMENTARY EXAMINATION /JULY 2016 29 JULY 2016 ; 08 :00-11 :00
DURATION	:	3 HOURS
WEIGHT	:	40: 60
TOTAL MARKS	:	**100**
FULL MARKS	:	**100**

ASSESSOR	:	MR. M.C MUTEBA
MODERATOR	:	MR P.BOKORO
NUMBER OF PAGES	:	4 PAGES

REQUIREMENTS

- STANDARD STATIONARY.
- NO-PROGRAMMABLE CALCULATOR MAY BE USED

INSTRUCTIONS

- READ INSTRUCTIONS CAREFULLY.
- ALL CALCULATIONS AND ANSWERS MUST BE DONE WITH A MINIMUM OF 3 DECIMALS.
- WRITING MUST BE IN BLUE OR BLACK INK PEN ONLY- NO PENCIL WRITING WILL BE MARKED
- WORK NEATLY, UNTIDY WORK MAY BE PENALIZED.
- ALL UNITS MUST BE SHOWN-MARKS WILL BE DEDUCTED FOR NO OR WRONG UNITS
- ALL CALCULATIONS MUST BE DONE IN COMPLEX NOTATION AND ANSWERS MUST BE WRITTEN IN POLAR FORM, WHERE APPLICABLE.

SECTION A
DC MACHINES

QUESTION 1 **[10 Marks]**

1.1. A 4-pole, wave-connected armature of a dc machine has 750 conductors and is driven at 720 r.p.m. If useful flux per pole is 15 mWb, determine the generated e.m.f. **(3)**

1.2.A 500 V, 250 kW, long shunt compound dc generator has the series, shunt and armature resistances of 0.04 Ω, 100 Ω and 0.01 Ω respectively. Neglect the contact brush voltage drop, calculate the generated e.m.f. **(7)**

QUESTION 2 **[18 Marks]**

2.1 The maximum current at starting of a 500 V dc shunt motor should not exceed 125 A. The armature resistance is 0.25 Ω. Calculate the values of the resistances of a 4-element starter. **(10)**

2.2 A dc series motor runs at 1000 r.p.m when taking 35 A from a 240 V supply. The total resistance of the armature and field circuits is 0.8 Ω. Calculate the value of the additional resistance required in series with the machine to drop the speed to 600 r.p.m if the gross torque is:

2.2.1 Constant, **(3)**
2.2.2 Proportional to the speed and **(3)**
2.2.3 Proportional to the cube of the speed **(2)**

[28 Marks]

SECTION B
SINGLE-PHASE TRANSFORMERS

QUESTION 1 **[13 Marks]**

1.1 The no-load current of a single-phase transformer is 5 A at 0.25 power factor lagging when supplied at 235 V, 50 Hz. The number of turns on the primary winding is 200. Calculate:

1.1.1 The maximum flux in the core **(3)**
1.1.2 The core loss current **(2)**
1.1.3 The magnetizing current **(2)**

1.2 A single-phase transformer with a ratio of 230/115 V is supplying a load current of 5 A, at 0.866 power factor lagging. The no-load current is 0.2 A at a power factor of 0.208 lagging. Calculate the primary current and power factor. **(6)**

QUESTION 2 **[22 Marks]**

The following readings were obtained from OC and SC tests on 8 kVA, 400/100 V transformer.

Open-Circuit (LV side): 60 W, 4 A, 100 V
Short-Circuit (HV side): 100 W, 20 A, 10 V

Compute:

2.1 The components of the no-load current **(4)**
2.2 The equivalents circuits parameters as referred to LV and HV sides **(10)**
2.3 Voltage regulation at full-load at 0.8 power factor lagging. **(2)**
2.4 The load at which the maximum efficiency occurs **(2)**
2.5 The efficiency at full-load for a 0.8 power factor lagging **(2)**
2.6 The efficiency at half-load for a 0.8 power factor lagging. **(2)**

[35 Marks]

SECTION C
THREE-PHASE INDUCTION MOTORS

QUESTION 1 **[8 Marks]**

A three-phase induction motor, at standstill, has a rotor voltage of 100 V between slip rings when open circuited. The rotor winding is star-connected and has a leakage reactance of 1 Ω/phase at standstill and a rotor resistance of 0.2 Ω/phase. Calculate;

1.1 The rotor current for a slip of 4 %, slip rings shorted. **(3)**
1.2 The slip and rotor current for a maximum torque. **(5)**

QUESTION 2 **[12 Marks]**

A 14.92 kW, 400 V, 950 r.p.m, three-phase, 50 Hz, 6-pole induction motor takes 6 times the full-load current at standstill and develops 1.8 times the full-load torque. The full-load current is 30 A. Compute;

2.1 The voltage to be applied to get full-load torque at start. **(3)**
2.2 The current that the above will produce. **(2)**
2.3 The line current if the voltage is obtained by an auto-transformer. **(3)**
2.4 The torque, as a percentage of full-load, if the starting current is limited to full-load by an Auto-transformer. **(4)**

[20 Marks]

SECTION D

FAULTS AND FAILURES IN ELECTRICAL MACHINES

QUESTION 1 **[17 Marks]**

1.1 One of faults in electrical machines is the short-circuit between turns of coil. Discuss

1.1.1 A least two methods of locating short-circuits between turns. **(4)**

1.1.2 A least one method of repairing short-circuits between turns. **(2)**

1.2 Name at least eleven general causes of failures of DC generators to give no-load voltage **(11)**

[17 Marks]

END