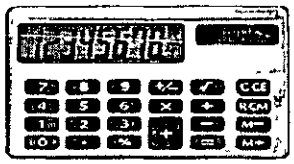
UNIVERSITY EXAMINATIONS



UNIVERSITEITSEKSAMENS

UNISA university of south africa

EMM2602
REM2602

October/November 2018

Electrical Machines II (Theory)

Duration 3 Hours

100 Marks

EXAMINERS

FIRST MR A VERSTEEG
SECOND MR AF COTTRELL

Programmable pocket calculator is permissible

Closed book examination

This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue

This examination question paper consists of 4 pages

Answer all the questions

PLEASE NOTE: IF YOU HAVE THE OPINION THAT INSUFFICIENT INFORMATION IS SUPPLIED FOR YOU TO ANSWER A PARTICULAR QUESTION, MAKE A REALISTIC ASSUMPTION, MOTIVATE IT AND THEN ANSWER THE QUESTION.

DC MACHINES
QUESTION 1

Explain the working of a commutator of a two pole DC generator

1 1 Draw a picture of a working commutator, the poles and an armature coil (4)

1 2 Explain how and when the commutator converts the AC in the armature coil to DC in the load and how will you compensate for armature reaction (3)
[7]

QUESTION 2

A 250-V, 6-pole, shunt motor has a lap wound armature with 500 conductors The armature and field resistances are 0 25 Ω and 125 Ω respectively and the flux per pole is 0 02 Wb If the motor takes 14 A from the supply and the rotational loss amount to 500 W

Draw the equivalent circuit and calculate the following

2 1 The speed of the motor (8)

2 2 Developed power in the armature (2)

2 3 Output power (2)

2 4 Output Torque (2)

2 5 Efficiency of the motor (3)
[17]

QUESTION 3

A 230 V DC shunt motor, running on no-load and at normal speed, takes an armature current of 3.5 A from the 230 V mains.

The field resistance is 230 Ω and the armature resistance is 0 3 Ω

Draw the equivalent circuits for the motor and the generator and calculate

3 1 The constant losses (7)

3 2 Motor output in kW and the efficiency when the total current it takes from the supply or mains is 35 A (5)

3 3 If the motor is used as a 230 V shunt generator, find the efficiency and output power for an output current of 35 A (6)
[18]

TRANSFORMERS
QUESTION 4

A 240/3300-V single phase transformer is supplied at 240 V on no-load on the low voltage side It takes a no-load current of 2 A and the power of 60 W
The resistance of the no load winding is 0 8 Ω

4 1 Draw the no-load equivalent circuit referred to the low voltage side, with variables, its ^{super} and $_{subscripts}$, and the values (1)

Calculate

4 2 The active or core current (I_c or I_{active}) (2)

4 3 The magnetizing current (I_μ) (4)

4 4 The copper loss in the low voltage winding As compared to the other losses, what can you assume in the future about this loss? (2)

4 5 The core loss (1)
[10]

[TURN OVER]

QUESTION 5

The equivalent circuit parameters referred to the low voltage of a 14 kVA, 250/2500 V, 50 Hz, single-phase transformer is given below

Rc = 500 Ω
Xμ = 250 Ω
Re1 = 0.2 Ω
Xe1 = 0 7 Ω

5 1 Draw the fully labelled equivalent circuit, referred to the low voltage side with values (4)

Calculate

5 2 The voltage regulation and secondary terminal voltage on full load, at a power factor of 0 8 lagging. (Ignoring the shunt circuit) (8)

5 3 Primary current and power factor if rated current is delivered to a load (on the high voltage side) at a power factor of 0.8 lagging Ignore volt drops in your reckoning (5)

5 4 The efficiency at half full load and the above power factor (7)
[24]

INDUCTION MACHINES
QUESTION 6

A 3 phase, a 4 pole, induction motor is operated at **60 Hz** Calculate.

6 1 Synchronous speed (2)

6 2 Rotor speed with as per unit slip = 0 08. (2)

6 3 Rotor speed when the rotor winding frequency is 6 Hz (4)

6.4 Rotor frequency when the rotor speed is 1500 rpm (4)
[12]

QUESTION 7

The rotor of a 6-pole 50 Hz induction motor has a per phase impedance of (2 +j10) Ω at standstill and a per phase emf of 110 V at standstill (this is not the voltage between phases)

Calculate The per phase motor current **and** power factor

7 1 At standstill (6)

7 2 When the rotor speed is 940 rpm (6)
[12]

TOTAL: [100]

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