TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION 2017/2018

BACHELOR OF SCIENCE (ELECTRICAL & ELECTRONIC ENGINEERING)

EEE 2306: ELECTRICAL MACHINES II

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: SEPTEMBER 2018

Instructions to Candidates

You should have the following for this examination
-*Answer Booklet, examination pass and student ID*
This paper consists of FIVE questions. Attempt **Question ONE (Compulsory)** and any other **TWO Questions**
Do not write on the question paper.

Question ONE (Compulsory)

a. Explain why transformer rating is given in kVA and not in kW. **(3 marks)**

b. Using appropriate diagram(s) explain the working principle of single-phase induction motor **(10 marks)**

c. A 100 kVA, 3-phase, 50 Hz transformer has a voltage ratio (line voltages) of 11/0.415 kV and is delta-star connected. The resistances per phase are: high voltage 40 Ω, low voltage 0.8 Ω and the iron loss is 2000 W. The power factor of the load is 0.6 lagging. Calculate the value of efficiency at half load **(9 marks)**

d. The power input to a 415 V, 50 Hz, 4-pole, 3-phase induction motor running at 1450 rpm is 15 kW. The stator losses are 0.5 kW and the friction and windage losses total 1 kW. Calculate:

i. The slip
ii. The rotor copper loss
iii. Shaft output
iv. The efficiency **(8 marks)**

Question TWO

a. Give the reasons that necessitate the need for connecting transformers in parallel. **(6 marks)**

b. State **FOUR** conditions that must be fulfilled in order to connect three-phase transformers in parallel **(4 marks)**

c. A load of 150 kVA at 0.866 power factor lagging is supplied by two 3-phase transformers of 100 kVA and 250 kVA capacity operating in parallel. The voltage transformation ratios of the two transformers are the same: 11,000 to 415 delta-star. If the equivalent secondary impedances are (0.01+j0.03) ohms and (0.028 + j0.05) ohms per phase respectively, calculate the load on each transformer. **(10 marks)**

Question THREE

a. List and explain three methods of controlling the speed of a slip-ring motor **(4 marks)**

b. Figure Q3 shows six windings of a 3-phase transformer wound on the transformer core.

   i. Complete the interconnections and properly label the terminals to realize a vector group-two (2).

   ii. Using vector diagrams, prove that the connections in (i) realized Vector group-two (2) transformer

(6 marks)

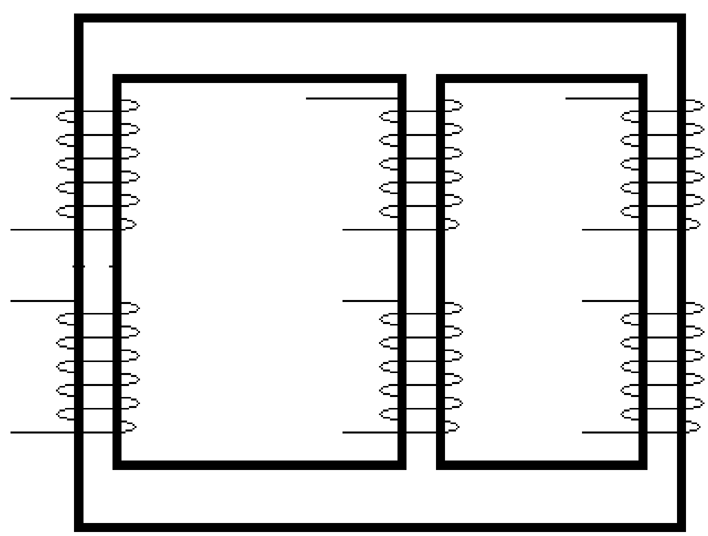

Figure Q3

c. A 200 kVA, Y-Y 3-phase, 50 Hz, 11,000/415 V transformer has an iron loss of 1600 W. The maximum efficiency occurs at 0.75 full load. Determine the efficiency of the transformer at:

   i. full-load and 0.8 power factor

ii. half-load and unity power factor

(10 marks)

Question FOUR

a. Draw an equivalent diagram of an induction motor and explain each parameter. **(4 marks)**

b. Explain what you would experimentally do to determine the parameters of an induction motor

(6 marks)

c. A 3-phase induction motor is driving full-load torque which is independent of speed. If the line voltage drops to 95% of the rated value, find the increase in motor copper losses. **(10 marks)**

Question FIVE

a. Calculate the percentage change in motor torque when the supply voltage to an induction motor is increases by 6%. **(3 marks)**

b. Explain what happens to the motor if two terminals to:

i. The slip-rings are interchanged?

ii. The stator windings are interchanged

(4 marks)

c. Sketch and explain the circle diagram of an induction motor **(7 marks)**

d. The star-connected rotor of a slip-ring induction motor has a standstill impedance of (0.4+j4) ohm per phase and the rheostat impedance per phase is 10 ohms. The motor has an induced emf of 100 V between slip-rings at standstill when connected to its normal supply voltage. Find rotor current:

i. At standstill with the rheostat in the circuit

ii. When the slip-rings are short-circuited and motor is running with a slip of 4%.

(6 marks)