UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY(ELECTRICAL POWER ENGINEERING)

EEP 22O4: ELECTRICAL MACHINES I

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2019

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

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 any any THREE **Questions**
Do not write on the question paper.

QUESTION ONE (Compulsory)

a)

    i)   State the TWO differences between a generator and a motor

    ii)   Derive the E.M.F equation of a D.C generator

    iii)   Draw the THREE important characteristic curves for a series generator on the same axes   (9marks)

b)

    i)   With the aid of a suitable diagrams, explain how the speed of a shunt motor can be changed by

        I)   Flux control method

        II)   Armature control method

    ii)   Describe regenerative braking as applied to dc motors   (5marks)

c)

    i)   Explain why a single phase induction motor is not self-starting

    ii)   A 4-pole, 250 W, 50Hz capacitor start induction motor takes full- load line current of 5.3A while running at 1440 rpm. If the full load efficiency is 70%, calculate:

        I)   Motor slip

        II)   Power factor   (6marks)

QUESTION TWO

a)

    i)   State two applications of the following motors:

        I)   Universal motor

        II)   Hysteresis motor

    ii)   With the aid of a diagram, explain the construction of a shaded pole induction motor   (11marks)

b)

    i)   With the aid of suitable diagrams, differentiate between capacitor- start motors and capacitor-start capacitor run motors.

    ii)   Giving reasons, state which of the motors mentioned in (b) (i) above will be suitable for use in hospitals and studios.   (9marks)

QUESTION THREE

a)

    i)   State THREE conditions necessary for voltage build up in a shunt generator

    ii)   State TWO reasons why the terminal voltage of a separately excited generator falls with increase in load   (5marks)

b) With the aid of a sketch, describe the following characteristics of a separately excited D.C generator

    i)   Open circuit characteristic

    ii)   Internal and external characteristic   (5marks)

c) Distinguish between short shunt and long shunt as applied to compound dc motor.

                                                                 (2marks)

d) A25KW, 250Vdc shunt generator has an armature and field resistance of 0.06Ω and 100Ω respectively. Determine the total armature power developed with the machine working as;

    i)   A generator developing 25KW output

    ii)   A motor taking 25KW input   (8marks)

QUESTION FOUR

a)

    i)   State any TWO applications of induction motors.

    ii)   With the aid of a suitable diagram, explain the stator resistance method of starting induction motors   (8marks)

b) Derive the expression of starting torque of a three phase induction motor.   (4marks)

c) A three-phase, star connected 400V, 50Hz 4-pole induction motor has the following per phase parameters in ohms referred to the stators.

$$R_1 = 0.15, X_1 = 0.45, R_2^{'} = 0.12, X_2^{'} = 0.45, X_m = 28.5$$

    i)   Draw the equivalent circuit diagram for the motor with all the values referred to the stator

    ii)   Given that the motor is operated at rated voltage and frequency with slip S = 0.04, compute the stator current and power factor   (8marks)

QUESTION FIVE

a)

    i)   State any THREE applications of DC shunt motors

    ii)   State TWO effects of armature reaction in dc machines   (5marks)

b) A dc motor takes an armature current of 110 A at 480V. The armature circuit resistance is 0.2Ω. The machine has 6 poles and the armature is lap connected with 864 conductors. The flux per pole is 0.05Wb. Calculate:

    i)   The speed

    ii)   The gross torque developed by the motor   (6marks)

c)

    i)   Define slip as used in induction motors.

ii)   The power input to a 6-pole, 3-phase induction motor is 42KW, the speed is 970rpm.The stator losses are 1.2KW and the friction and windage losses 1.8KW. Calculate

I)   Rotor Cu losses

II)   The efficiency of the motor   (9marks)