UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME   :   ELECTRICAL MACHINE

COURSE CODE   :   BBV 30203

PROGRAMME CODE   :   BBE

EXAMINATION DATE   :   JANUARY / FEBRUARY 2022

DURATION   :   3 HOURS

INSTRUCTION   :   1. ANSWER **ALL** QUESTIONS

                        2. THIS FINAL EXAMINATION IS A **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**

TERBUKA

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) State the definition of
(i) generator

(2 marks)

(ii) motor

(2 marks)

(b) Sketch the basic construction of a DC motor and a single-phase AC motor including permanent magnet, conductor, commutator and other components involved. Explain the differences regarding basic construction for both of the motors.

(8 marks)

(c) Draw the graph of output voltage versus angle for DC generator (from 0^0 to 360^0). State the angles when the maximum generated voltage is reached. Explain the reason.
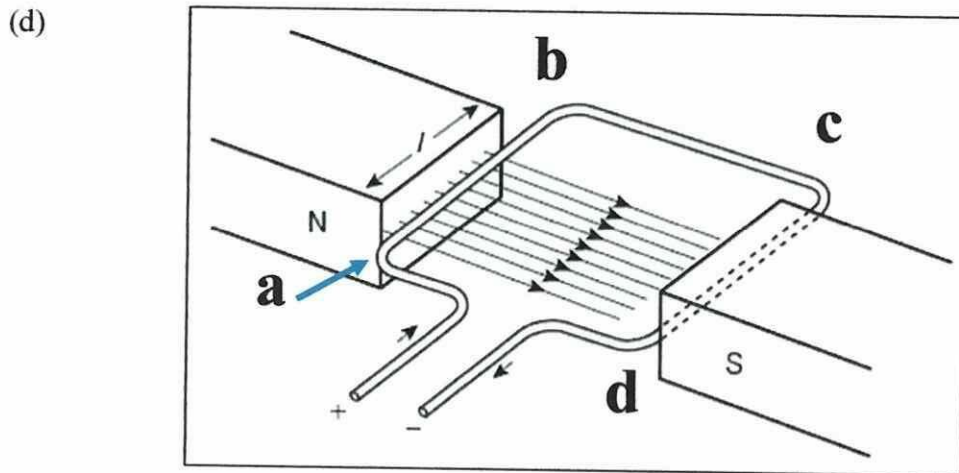
(7 marks)

(d)

Figure Q1(d)

(i) According to **Figure Q1(d)**, state the basic formula to produce induced e.m.f.

(2 marks)

(ii) By using suitable Flemming's hand rule, explain the operation of **Figure Q1(d)** in terms of direction of the rotor using the help of label a, b, c and d.

(4 marks)

TERBUKA

CONFIDENTIAL

Q2   (a)   For the large AC three phase generator, it is more practical to rotate the magnetic field and fix armature winding. By using a suitable diagram, show how the three phase AC voltage is generated by the large three phase generator.

(8 marks)

(b)   A synchronous generator with four (4) poles is attached to prime mover. Determine the synchronous speed of generator in order to produce a voltage with frequency of
       (i)   50 Hz.

(2 marks)

       (ii)   60 Hz.

(2 marks)

(c)   A rectangular coil of sides 12 cm and 8 cm is rotated in a magnetic field of flux density 1.4 T. The longer side of the coil actually cutting this flux. The coil is made up of 80 turns and rotates at 1200 rev/min.
       (i)   Calculate the maximum generated e.m.f.

(3 marks)
       (ii)   If the coil generates 90 V, determine the speed of the coil to rotate.

(5 marks)

(d)   List three (3) types of single phase induction motor.

(3 marks)

(e)   Draw the equivalent circuit for one (1) of the types of single phase induction motor in question **Q2 (d).**

(2 marks)

Q3   (a)   Draw and label the equivalent circuit of DC motor listed below with detailed parameters.
       (i)   Shunt-wound motor.

(2 marks)
       (ii)   Series-wound motor.

(2 marks)

(b)   A 200V DC shunt motor draws 10A at 1600 rpm. The armature resistance is 0.1 Ω field winding resistance is 440 Ω.
       (i)   Calculate the torque.

(6 marks)
       (ii)   Calculate the speed and line current at a torque of 20 Nm (if field current is constant).

(6 marks)
       (iii) Discuss the characteristics of shunt wound motor for torque – speed characteristics from the calculation

(1 mark)

CONFIDENTIAL

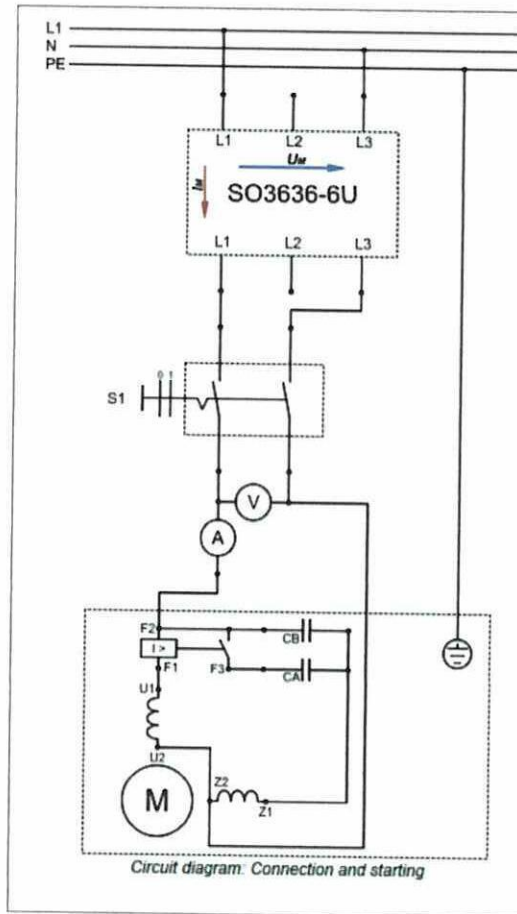(c)   **Figure Q3(c)** shows the connection and starting for capacitor motor.

Figure Q3 (c)

(i)   In which direction does the motor in **Figure Q3(c)** turn?

(1 mark)

(ii)   Draw the circuit in **Figure Q3(c)** with some modification to make the motor turns to the opposite direction.

(4 marks)

(d)   Determine the rotation for each circuit connection below based on **Figure Q3(c)**
    (i)   L1 - F2, F1 - U2, N - U1 - Z2, Z1 - CA - CB
    (ii)   L1 - F2, F1 - U2, N - U1 - Z1, Z2 - CA - CB
    (iii)   L1 - F2, F1 - U1, N - U2 - Z1, Z2 - CA - CB

(3 marks)

CONFIDENTIAL

Q4   **(a)**

Table Q4 (i)

n/(1/min)	3500	3250	3000	2750	2500	2250	2000
I/A	0.87	1.02	1.23	1.49	1.82	2.17	2.55
M/Nm	0.29	0.37	0.47	0.62	0.8	1	1.22

Table Q4 (ii)

n/(1/min)	3500	3250	3000	2750	2500	2250	2000
I/A	2	2.13	2.29	2.47	2.64	2.84	3
M/Nm	0.55	0.6	0.66	0.73	0.78	0.85	0.89

Table Q4 (i) shows the result for AC Connection and starting experiment for Universal Motor and **Table Q4 (ii)** shows the results for DC Connection and starting experiment for Universal Motor

(i)   State the exact type of the motor.

(ii)   From the **Table Q4 (i)** and **Q4 (ii)**, discuss the load characteristics for AC and DC connection for the universal motor?

(4 marks)

(b)   **Figure Q4(b)** shows a graph of load characteristics for universal motor for load machine 1.
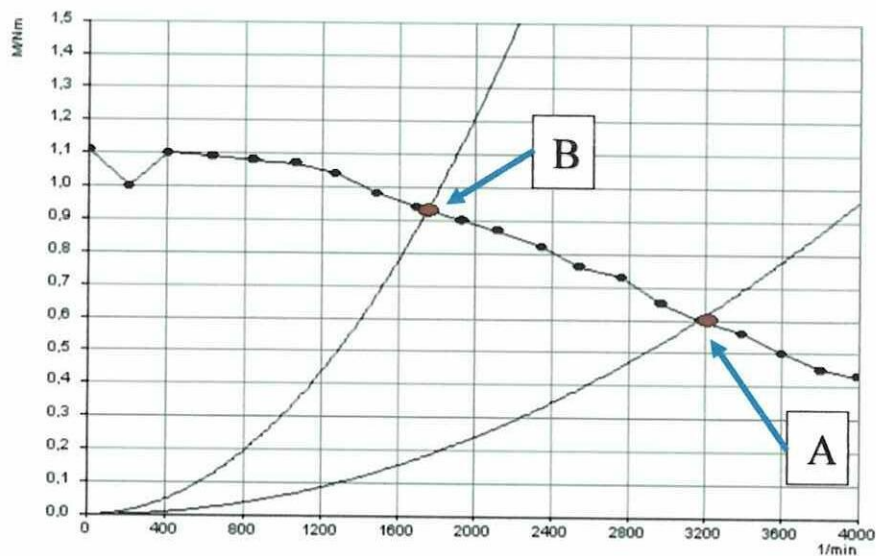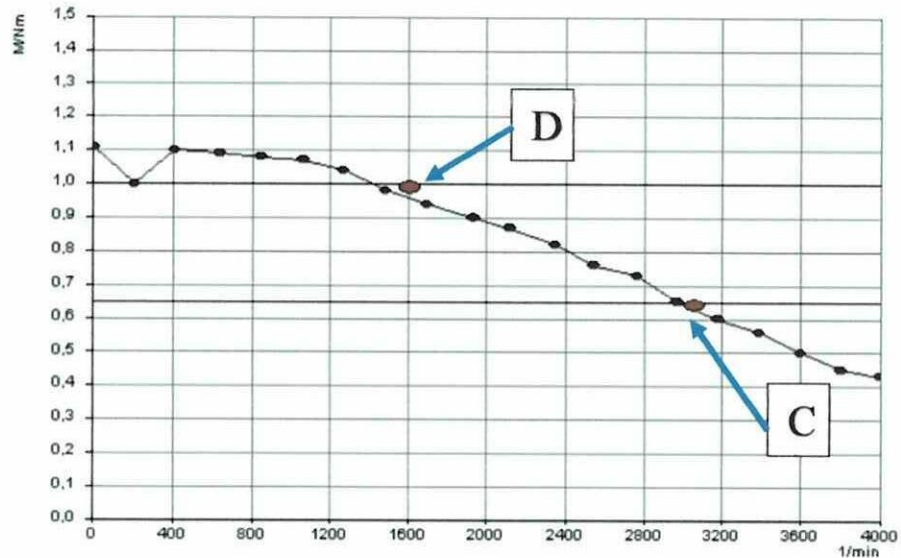

Figure Q4(b)

(i)   Name the type of load machine 1 in **Figure Q4(b)**.

(1 mark)

(ii)   According to **Figure Q4(b)**, explain the graph by comparing point A and point B. (Include the parameters in the graph and the characteristics of the type of the load machine).

(5 marks)

CONFIDENTIAL

(c) **Figure Q4(c)** shows a graph of load characteristics for universal motor for load machine 2.

(1 mark)

(ii) According to Figure Q4(c), explain the graph by comparing point C and point D. (Include the parameters in the graph and the characteristics of the type of the load machine).

(5 marks)

(d) Conclude the load characteristics obtained for both load machines in **Figure Q4 (b)** and **Q4 (c)**?

(4 marks)

(e) List five (5) maintenance activities to be done during periodic maintenance process for three phase induction motors to make sure the motors are in good condition.

(5 marks)

-END OF QUESTIONS -