UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2019

COURSE NO: EL 274
COURSE NAME: DIRECT CURRENT MACHINES
CLASS: EL II **TIME:** 3 HOURS

Name**:** _____Index Number: _____

Attempt all questions in Section A and B. Circle the correct answer in Section A.

SECTION A [20 marks]

1. Torque development in a dc motor depends on:
   a. Magnetic field and radius of armature
   b. Current flowing through the armature conductors
   c. Active length of the conductors and number of armature conductors
   d. All the above
2. For very sensitive and wide speed control, the preferable control method is
   a. Armature control
   b. Ward-Leonard control
   c. Multiple voltage control
   d. Field control
3. If terminal voltage of one 1000 rpm shunt motor is reduced to half the speed of the motor will be
   a. 500 rpm
   b. 250 rpm
   c. 1000 rpm
   d. 2000 rpm
4. Armature reaction also take place in generators, but it is in opposite direction to that of dc motors.
   a. True
   b. False
5. Armature reaction causes an increase of magnetic flux.
   a. True
   b. False
6. A long air gap can considerably increase the reluctance of the magnetic circuit.
   a. True
   b. False
7. In a dc motor, the shaft torque is less than armature torque. This is due to:
   a. Eddy current loss
   b. Hysteresis loss
   c. Stray loss
   d. All the above
8. Armature reaction causes a distortion of the magnetic field depending upon the load.

a. True b. False

9. Commutation is the action of transferring current from the armature conductors through the commutator segments and brushes to the external circuit.

a. True b. False

10. A long air gap can considerably increase the reluctance of the magnetic circuit.

a. True b. False

11. The type of generator is absolutely independent of the manner in which the field winding is bolted on the yoke.

a. True b. False

12. An extremely low-resistance field winding of very few turns of heavy wire is used in series motors.

a. True b. False

13. The magnetic field in the machine is produced in the armature windings.

a. True b. False

14. The speed of dc shunt motor can be increased above its normal speed by:

a. Increasing the field current
b. Decreasing the field current
c. Decreasing the terminal voltage
d. Increasing the armature resistance

15. The starting torque of dc shunt motor is:

a. Zero
b. Low than that of a series motor of the same ratings
c. High than that of a series motor of the same ratings
d. Same as that of a series motor of the same ratings

16. In an electrical motor, the electromagnetic torque developed is:

a. In opposite direction to both load torque and fractional torque
b. In the same direction to the load torque but opposite direction to the fractional torque
c. In the same direction as the load torque and fractional torque
d. In the same direction as the fractional torque but in opposite direction to the load torque

17. A dc motor having full load speed of 75 rpm and speed regulation of 10% will have no load speed of:

a. 825 rpm
b. 800 rpm
c. 675 rpm
d. 700 rpm

18. During commutation, the coil undergoing commutation …… by the brush

a. remains short-circuited
b. remains open-circuited
c. either (a) or (b)
d. none of the above

19. In a d.c generator, the effect of armature reaction on the main pole flux is to

a. reduce it
b. distort it
c. both reduce and distort it
d. reverse it

20. The following are essential part of servo motors and their operations except

a. Gear reduction unit
b. Servo fillers
c. Control circuit
d. Position sensing device

SECTION B

Answer all questions [40 Marks]

Question 1

A 250 V, 32 kW 1200 rpm, DC shunt motor has a full load efficiency of 89%. The armature resistance is 0.3 Ω and total brush drop is 2 V. The value of the field current is 2 A. Find

i. full load line current [2 marks]

ii. full load shaft torque [1 mark]

iii. total resistance in the motor starter (in series with armature) to limit the starting current to 1.5 times the full load current [3 marks]

Question 2

a. An 8 pole DC series motor has 944 wave connected armature conductors. At a certain load, the flux per pole is 35 mWb and the total mechanical power developed is 250 Nm. Find the line current drawn by the motor and the speed at which it will run with an applied voltage of 250 V. The total motor resistance is 2.5 Ω. [3 marks]

b. Automobile power steering employs which type of DC motor in operation. [1 mark]

Question 3

a. Draw and label the load characteristics of separately excited generator. [4 marks]

b. A series generator delivers 25 kW to a load which requires a 250 V terminal voltage supply. It armature and series field resistance are 0.1 Ω and 0.055 Ω respectively. Find

i. the armature current; and [1 mark]

ii. the generated emf. [1 mark]

Question 4

a. What are the names for the labels A-E in Figure 1? [5 marks]

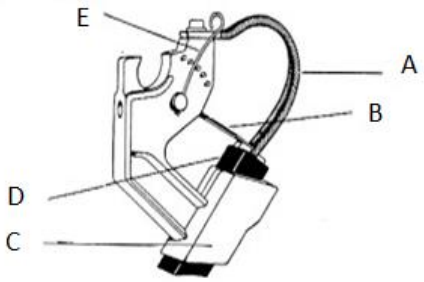

Figure 1

b. State the 3 main types of Brush Angles [3 marks]

c. A technician needs to replace worn-out brush. What will be the main recommendation you will provide to him as an engineer. [1 mark]

d. A 3-pair pole lap connected generator has a useful flux/pole of 0.045 Wb. If the no load voltage at 400 rpm is 300 V, find the conductors on the armature periphery. [2 marks]

Question 5

a. What is the name of the manual starter in Figure 2? [1 mark]

b. What are the names and functions of AA and B in Figure 2? [4 marks]

c. What type of motor is this starter connected to in Figure 2? [1 mark]

d. What will be the consequence of the named label B malfunctioning in Figure 2? [2 marks]

e. State the main advantage and disadvantage of the Ward-Leonard method of speed control of a dc motor. [2 marks]

f. What is the difference between continuous rating and continuous maximum rating of a dc machine? [2 marks]

g. What type of enclosure would you select for a motor that will be placed below the water found in /occupying a drilled well? [1 mark]

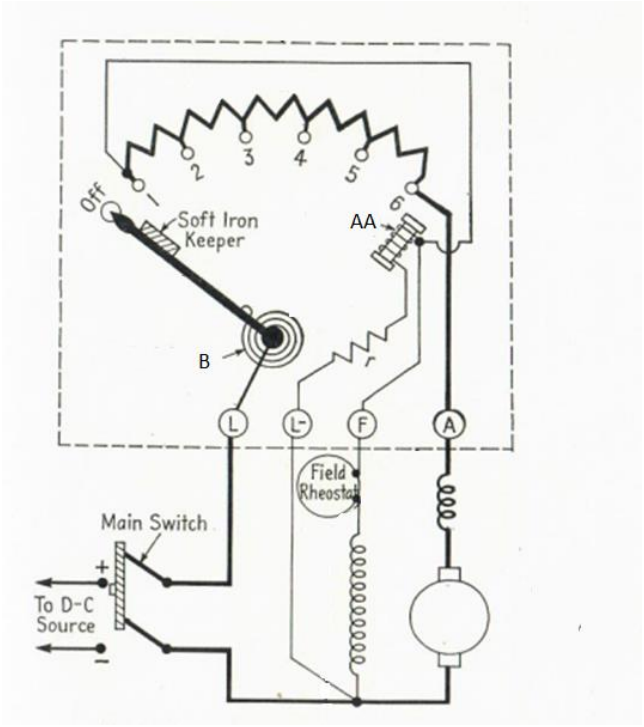

Figure 2

Examiners: I. Aidoo/A. B. Asiedu-Asante