



Final Exam
Total marks: 50 marks
Examination weight: 50%

Electrical Machines
(0908321)
Dr. Musa Al-Yaman

No. of questions: 3
No. of pages:3
Examination Time: 60 Minutes

Q1) Fill in the blanks:

(20 Marks)

1. What are the four basic principles describe how magnetic fields are used:
A) _____ B) _____
C) _____ D) _____
2. Why transformers are important to modern life? _____.
3. What are the DC Motor four major components?
A) _____ B) _____
C) _____ D) _____
4. How we control the speed of DC Motor? _____.
5. The major two classes of AC Machines are: A) _____ B) _____
6. The main two types of induction motor rotors are: A) _____ B) _____
7. The main two methods to start Synchronous Motors are: A) _____ B) _____
8. What are the two main modifications to the universal motor to allow it for proper AC supply operation? A) _____ B) _____
9. The main reasons to oversize a motor are: A) _____ B) _____ C) _____
10. Why alternator is connected to the motor? _____.



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Q3) Solve the following three parts.

(15 Marks)

A) A 480-V, 50 Hz, 60-hp, a three-phase induction motor is drawing 50A at 0.9 PF lagging. The stator copper losses are 4 kW, and the rotor copper losses are 1 kW. The friction and windage losses are 400 W, the core losses are 2 kW, and the stray losses are 1% of input power. Find the following quantities: (5 marks)

- The air-gap power P_{AG} .
- The power converted P_{conv} .
- The output power P_{out} .
- The slip
- The efficiency.

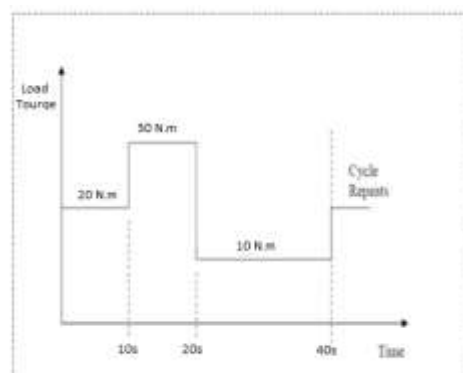
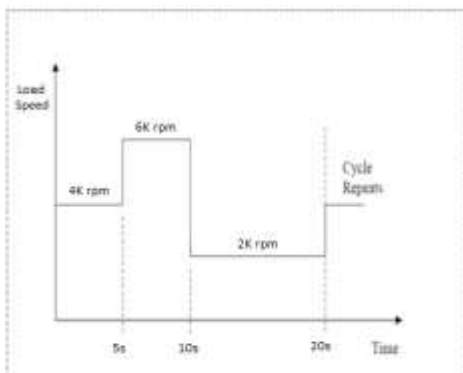
B) A Bipolar Hybrid Stepper Motor is derived by the A4988 chip, it has a total of six stator poles, the rotor has 25 teeth, and the stator has four poles. Study the table below; then answer the following questions. (Assume the motor start at angle 0, if Direction equals 0 the motor rotate CW (clockwise) and if Direction equals 1 the motor rotate CCW (counter clockwise)) (5 marks)

- Find the motor position after finishing the B period.
- Find the Direction and No. of steps needed at E Period to have a motor position at 180 degrees from starting position.
- The motor final position.

Period	Direction	No. of steps
A	1	10
B	0	15
C	0	20
D	1	15
E	?	?
F	1	5

C) Answer the following questions according to the figure below: (5 marks)

- Find the Power-Load profile (i.e. Power vs. Time curve for the Load).
- Choose an appropriately sized motor to drive this load assuming a service factor of 10%. You do not need to consider starting performance.





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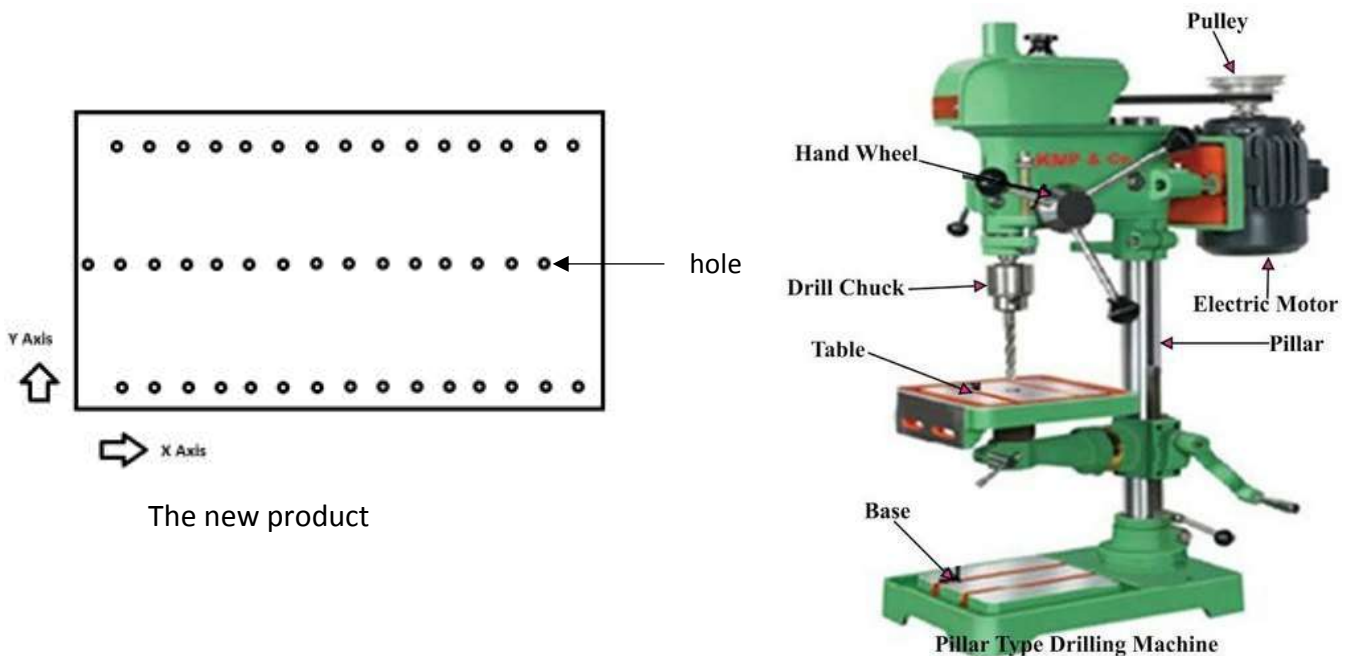
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Q3) Design the needed below for the following description. (15 Marks)

You are the design engineer in a factory, the figure below shows an old drilling machine that has a single-phase squirrel-cage induction motor to rotate the drill chuck, the factory manager ask you to upgrade the drilling machine to adapt the new product (shown below) mass production. The upgrade needs to have automated 3-D movements by adding a motor in each axis to control its movements as described below.



- Select the needed type and draw the needed connections for the X-direction motor to do precise movements in X-direction with high speed and constant time movements from the first hole till the last hole in each row. (You need to justify your answer and selections)
- Select the needed type and draw the needed connections for the Y-direction motor to do the slow movements in Y-direction with constant torque (You need to justify your answer and selections).
- Select the needed type and draw the needed connections for the Z-direction motor to do small bi-directional movements in Z-direction with high different torque values to derive different materials types. (You need to justify your answer and selections)