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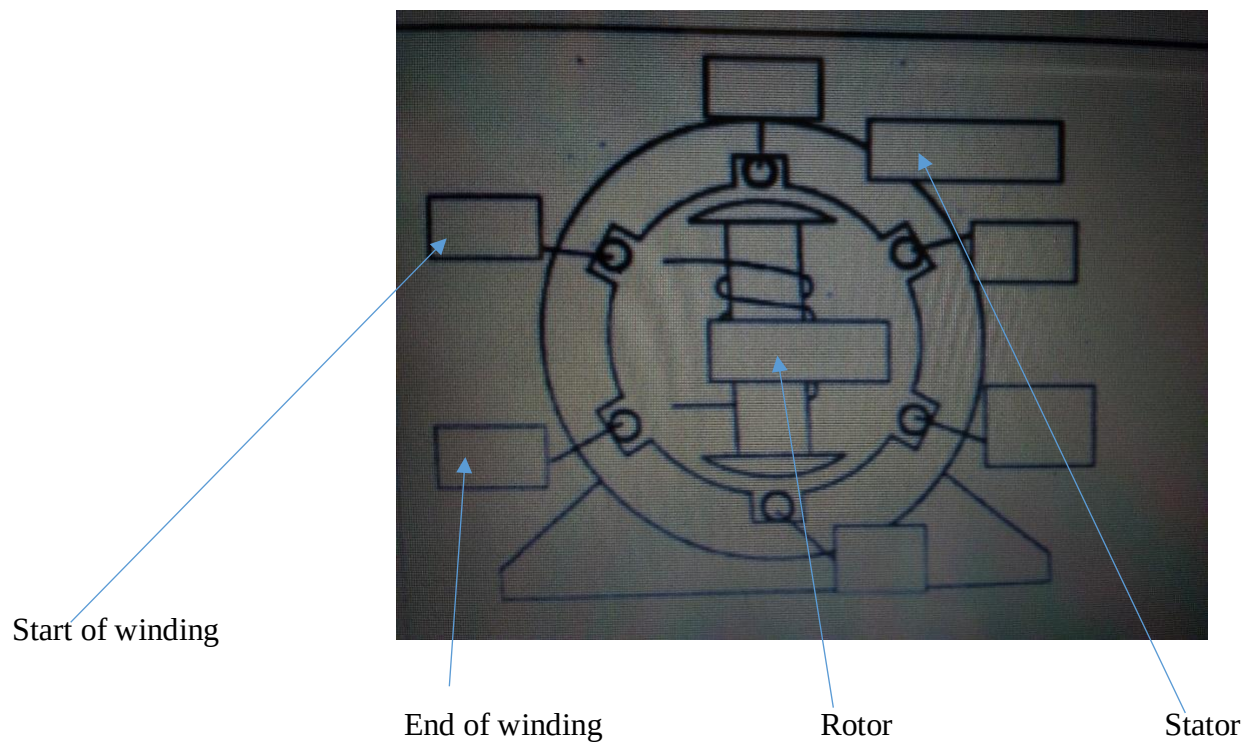
Course:

Professor:

Date:

Single and three phase motors

Question 1



Question 2

- a) Salient pole rotor
- b) Cylindrical rotor

Question 3

To induce an EMF in a winding, relative motion between the winding and a magnetic field is required.

In larger alternators the magnetic field is easier to move than the windings, so the rotor, which is driven by a prime mover (such as steam), consists of an electromagnet.

The revolving electromagnet must be supplied with a current from a stationary DC voltage source via slip rings.

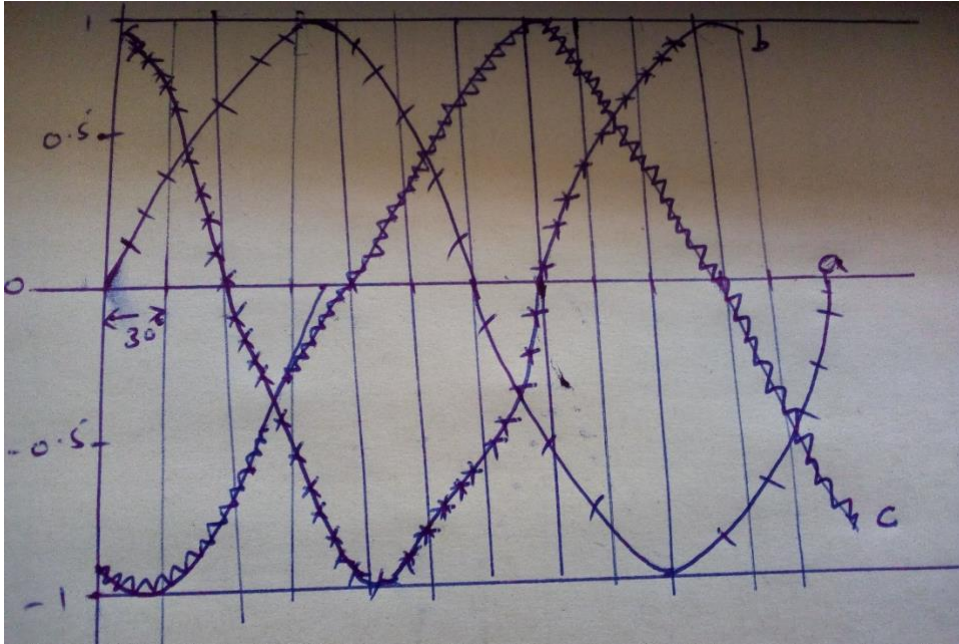
As the electromagnet moves past the winding, an EMF is induced in the winding proportional to its angular position creating a sinusoidal waveform.

For a single phase alternator, there is one winding and for a three phase alternator there are three windings. Each winding produces an alternating voltage.

Question 4

Waveforms of the three outputs of a two pole three phase alternator for one revolution.

Horizontal axis 30° intervals.



Question 5

- a) The speed of a 16 pole alternator to produce a frequency of 50Hz is =

$$\text{Frequency} = \frac{PN}{120}$$

$$50 = \frac{(16 \times N)}{120}$$

$$6000 = 16N$$

$$N = 375\text{rpm}$$

- b) $50 = \frac{3000P}{120}$

$$6000 = 3000P$$

$$P = 2$$

- c) $F = \frac{(4 \times 1500)}{120}$

$$F = 50\text{Hz}$$

Question 6

- a) Watt is the SI unit for power which is equal to one joule per second and corresponds to the rate of power consumption in a circuit with a voltage of 1 volt and one ampere current.

On the other hand, horsepower is an imperial unit which is used to measure the rate at which power is consumed and is equivalent to the power required to raise 550 pounds to a distance of 1 foot, approximately 750 watts.

- b) 1 Hp = 750 watts

$$1 \text{ Hp} = 0.75 \text{ kw}$$

$$5 \text{ Hp} = 3.75 \text{kw}.$$

Question 7

Description of universal motor component	Label number
Motor shaft	4
Armature	8
Motor housing	5
Fan	6
Commutator	2
Spring	7
Brush holder	3
Carbon brush	1

Question 8

- a) Capacitor start capacitor run motor
- b) Shaded pole motor
- c) Stator
- d) Wound rotor
- e) Starting capacitors
- f) Rotor

Question 9

Type of enclosure	Features
Has no external vents	Water proof, splash proof
Totally enclosed fan ventilated	Dust proof
Drip proof and screen protected	Openings positioned to protect against drops of water and screen to protect vents.

Question 10

Motor type	Components for starting	Cause of rotating magnetic field	Application	Reasons for choice

		and starting torque		
Split phase	2	1	6	4
Capacitor start	3	3	2	1
Capacitor start capacitor run	6	5	3	3
Permanently split	5	4	4	2
Shaded pole	4	6	5	6
Universal	1	2	3	5

Question 11

One method which is used to control the speed of a single phase induction motor is controlling the voltage applied to the stator of the motor. This can be achieved by controlling the resistances of the windings.

Question 12

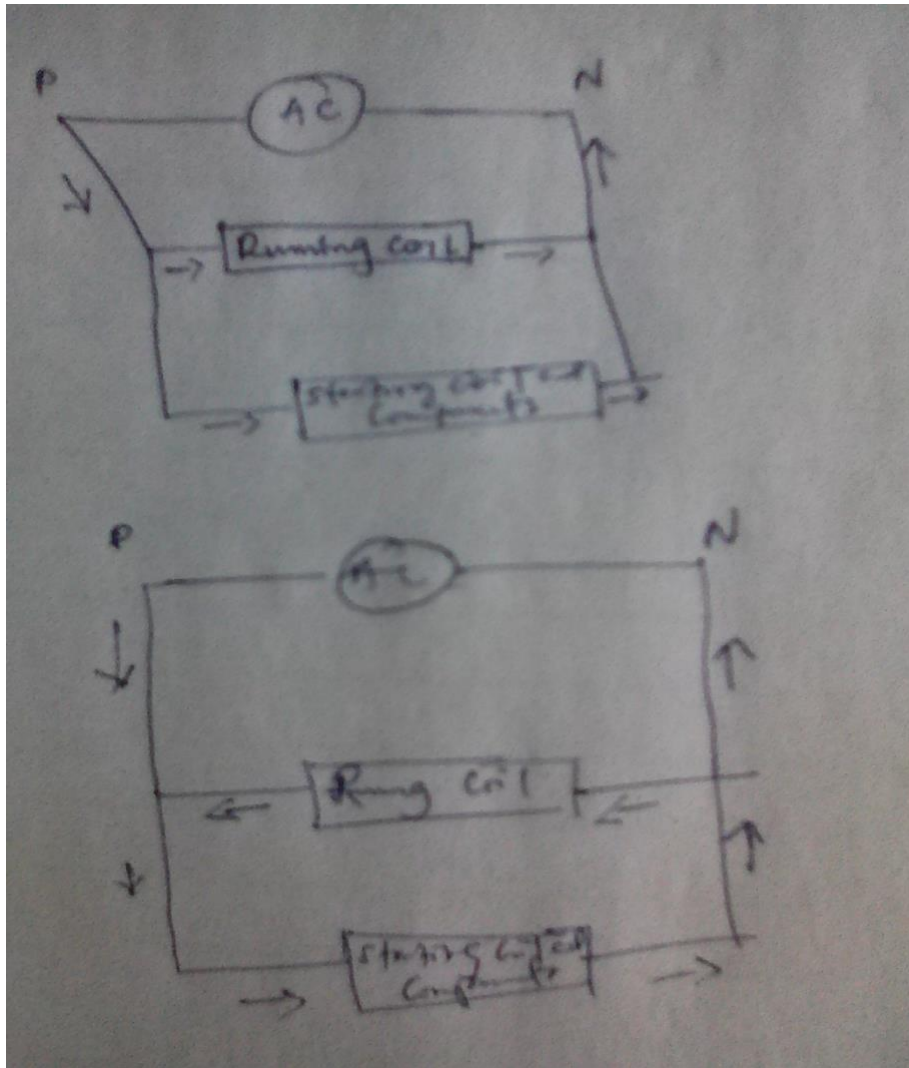
Speed control methods for a universal motor include centrifugal mechanism, resistance speed control method, field tapping, controlling voltage, and controlling the current in the main windings.

Question 13

In a universal motor, the direction of rotation can be reversed by reversing the current in the field circuit. When running on AC voltage, a reactance voltage is introduced which minimizes the current. A compensation winding is used and connected in series with the armature and field winding to produce current in the opposite direction. Which cancels out the effect of inductance causing a reactance.

Question 14

Voltage flowing in the running coil is controlled and current allowed to flow in the opposite direction, reversing the current in the field circuit. Current in the starting coil flows in a different direction from that in the starting coil and components.



Question 15

Description of component	Label number
Rotor	3

Stator	4
Terminal box	7
Fan	6
Mounting Block or foot	8
End shield DE	5
Bearing	1
End shield NDE	9
Shaft	2
Fan cover	10

Question 16

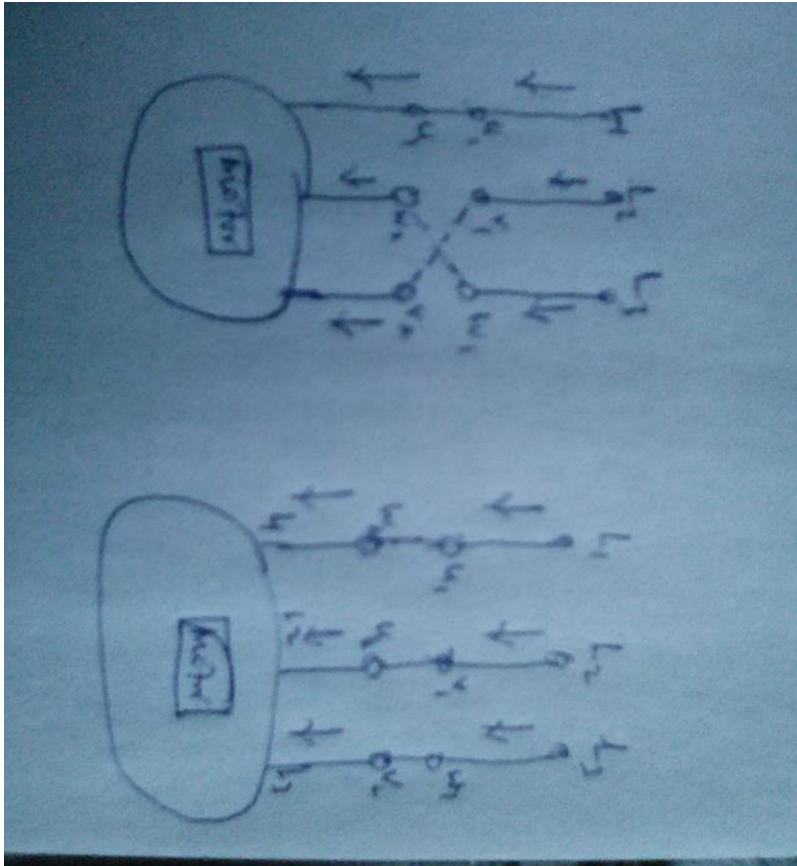
Motor component	Description of the component
1	Wound rotor
2	Single cage rotor
3	Double cage rotor

Question 17

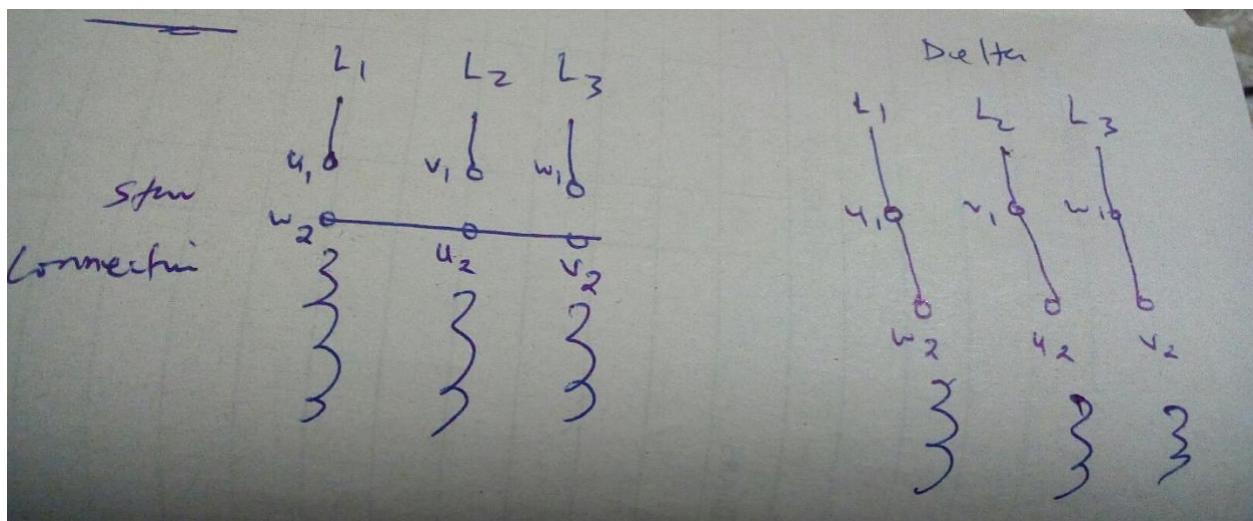
The **three** stator windings are situated 120 degrees apart from each other. The three phase currents are **120 degrees** out of phase with each other. These magnetic fields created by the stator thus produce a resultant **rotating** magnetic field. This rotating magnetic field rotates past the rotor bars and induces an **EMF** in them. The rotor bars are connected by the **end rings** and form an electric current. An electric **current** flows in the **rotor bars**. This rotor current produces another **magnetic** field. The two magnetic fields produce **a torque** in the direction of the stator rotating magnetic field. The rotor starts to move in the **same** direction of the rotating magnetic field.

Question 18

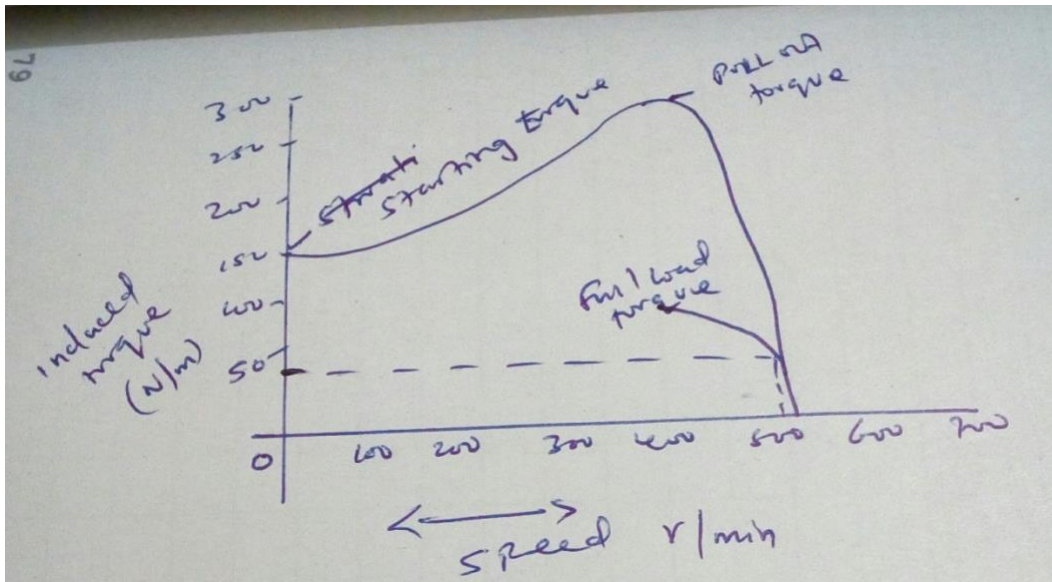
Voltage flowing in the running coil is controlled and current allowed to flow in the opposite direction, reversing the current in the field circuit.



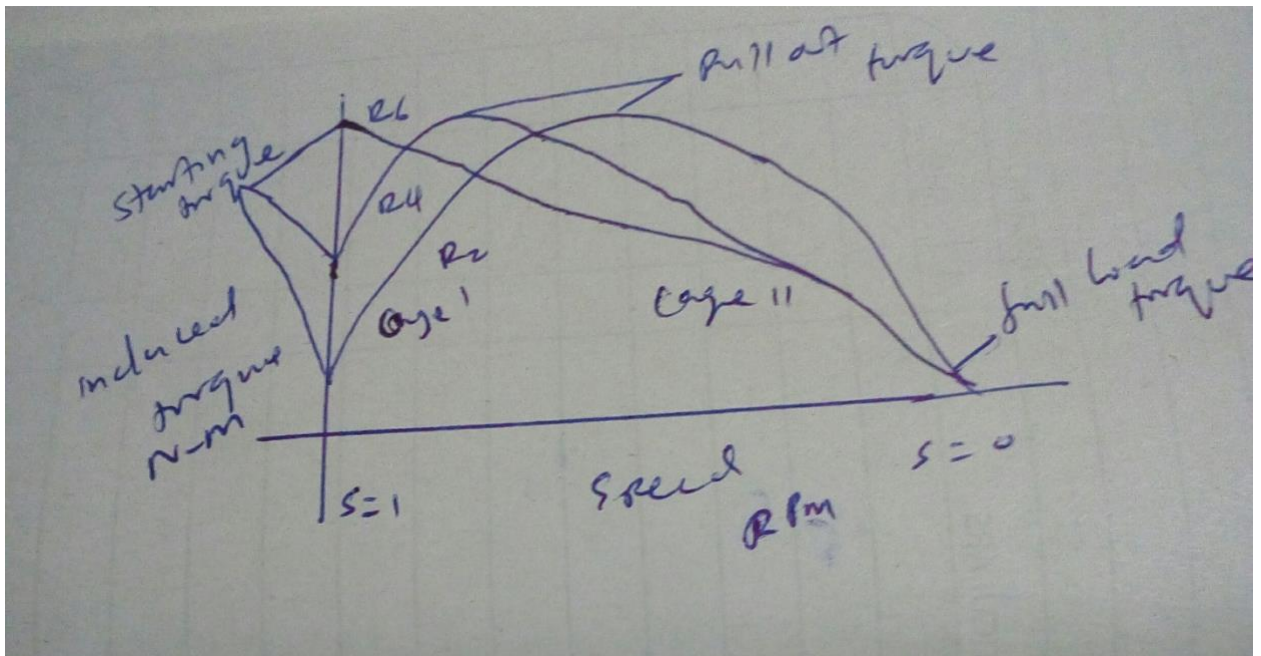
Question 19



Question 20

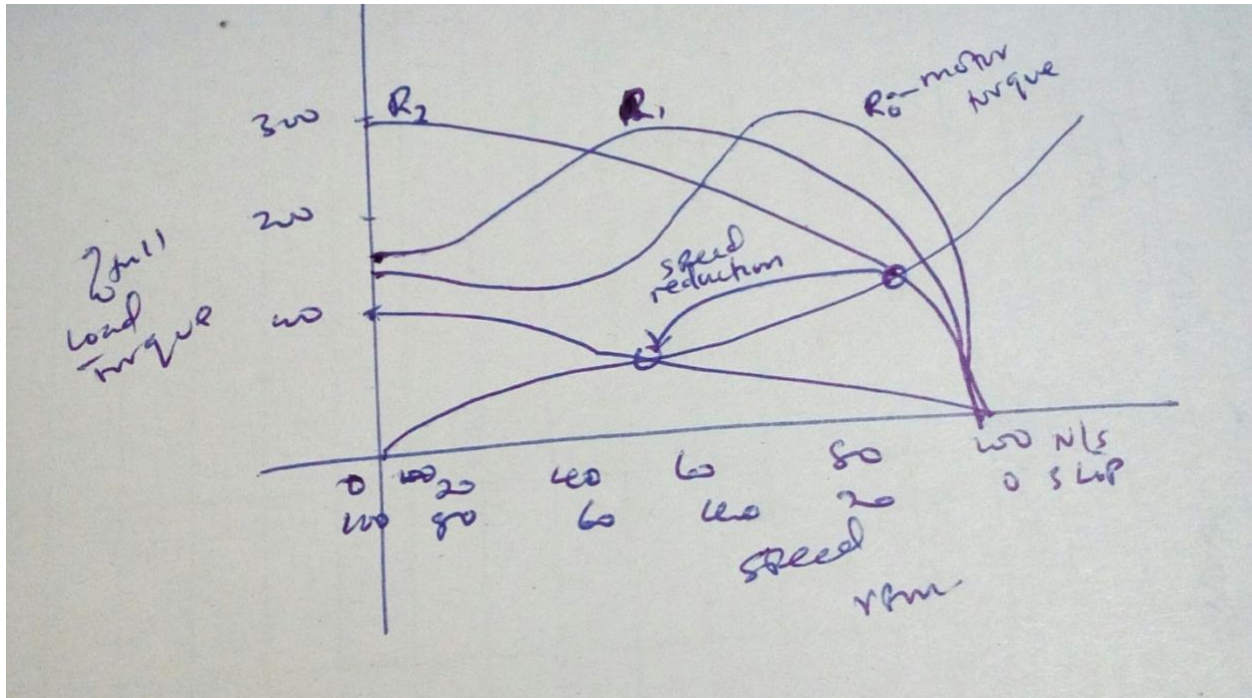


a)



b)

Question 21



Question 22

Rotor type	Application	Reasons
Squirrel cage rotor	E	A
Double cage rotor	F	D
Wound rotor	B	C