SHORT QUESTIONS AND ANSWERS

UNIT-I - SYNCHRONOUS RELUCTANCE MOTOR

1. What is synchronous reluctance motor?

- A **reluctance motor** is a type of synchronous electric motor which induces non-permanent magnetic poles on the ferromagnetic rotor. Torque is generated through the phenomenon of magnetic reluctance.
- The stator consists of multiple salient (ie. projecting) electromagnet poles, similar to a wound field brushed DC motor. The rotor consists of soft magnetic material, such as laminated silicon steel, which has multiple projections acting as salient magnetic poles through magnetic reluctance.
- The number of rotor poles is typically less than the number of stator poles, which minimizes torque ripple and prevents the poles from all aligning simultaneously -- a position which can not generate torque.

2. Define the characteristics of synchronous reluctance motor.

The synchronous reluctance motor is not self starting without the squirrel cage. During run up it behaves as an induction motor but as it approaches synchronous speed, the reluctance torque takes over and the motor locks into synchronous speed.

3. Write the applications of syrm.

Used where regulated speed control is required in applications suc as metering pumps and industrial process equipment.

4. What are the classification of syrm

- Axially laminated
- Radially laminated

5. What are the primary design consideration of syrm?

- High o/p power capability
- Ability of the rotor to withstand high speed.
- High reliability
- Low cost
- High efficiency

6. Define power factor of syrm

PF max=(Ld/Lq-1)/(Ld/Lq+1)
Higher Ld/Lq ratos yield higher power factors,which corresponds to reduced I^2R losses and reduce volt ampere ratings of the inverter driving the machine.

7. What are the applications of the torque – speed characteristics of syrm?

- Comparable power density but better efficiency than induction motor
- Slightly lower power factor
- Sensorless control is much easier due to motor saliency.

8. What are advantages of syrm over pm machine?

- More reliable than PM machine
- There need not be any excitation field as torque is zero,thus eleiminating electro magnetic spinning losses.

9. What are applications of syrm?

- Synthetic fiber manufacturing equipment
- Wrapping and folding machine
- Auxiliary time mechanism
- Synchronized conveyors
- Metering pumps

10. What are the advantages of syrm ?

a. Freedom from pm
b. Ability to maintain full load torque at zero speed
c. A wide speed range at constant power.

11. What are the classifications of SYRM?

- ✓ Rotor configuration
  i)cage rotor for line start
  ii)cageless-rotors for variable speed
- ✓ Stator windings
- ✓ Stator current controlled mode

PART B

1. Explain the constructions and working principle of synchronous reluctance motor. (16)
2. Explain in detail about classification of synchronous reluctance motor. (16)
3. Draw the phasor diagram of synchronous reluctance motor. (16)
4. Derive the torque equation of synchronous reluctance motor. (16)
5. Draw and explain the characteristics of synchronous reluctance motor. (16)
6. Explain in detail about vernier motor. (16)

UNIT – II - STEPPER MOTORS

1. What is stepper motor?

A stepper motor is a digital actuator whose input is in the form of programmed energization of the stator windings and whose output is in the form of discrete angular rotation.

2. Define step angle.

Step angle is definrd as the angle through which the motor rotates for each command pulse.it is denoted as β.

β=(Ns-Nr/Ns.Nr)360 (or)360/(mNr)

3. Define slewing

The stepper motor operates at very high speed is called slew angle.i,e (25000 steps per sec).

4. Define resolution

It is defined as the no.of steps needed to complete one revolution of the shaft.
Resolution = no . of steps /revolution

5. Mention some applications of stepper motor

I.floppy disc drives
ii. qurtz watch
iii. camera shutter operation
iv. dot matrix and line printers
v. small tool application
vi. robotics

6. What are the advantages and disadvantages of stepper motor?

Adv:
1. it can be driven in open loop without feedback
2. it is mechanically simple
3. it requires little or no maintenance.

Disadv:
1.low efficiency
2.fixed step angle
3.limited power output

7. Define holding torque.

Holding torque is the maximum load torque which the energized stepper motor can withstand without slipping from equilibrium position

8. Define detent torque

Detent torque is the maximum torque which the unenergised stepper motor can withstand without slipping.it is also known as cogging torque.

9. What is meant by full step operation?

Full step operation or single phase on mode is the one in which at a time only one phase winding is energized, due to which one stator winding is energized and causes the rotor to rotate some angle.

10. What is meant by two phase mode of operation?

Two phase on mode is the one in which two phase windings are energized at a time, due to which two stator windings are energized and causes the rotor to rotate through some angle.

11. Define pull in torque.

It is the maximum torque the stepper motor can develop in start – stop mode at a given stepping rate Fs (step/sec) without losing synchronism.

12. Define pull out torque.

It is the maximum torque the stepper motor can develop in slewing mode at a given stepping rate Fs (step/sec) without losing synchronism.

13. What is synchronism in stepper motor?

It is the one to one correspondence between the number the number of pulses applied to the stepper motor and the number of steps through which the motor has actually moved.

14. Give the types of driver circuits.

- Resistance or L/R drive
- Dual voltage or bilevel drive
- Chopper drive

15. What is multi stack VR motor

Multi stack VR motor is the one in which the stepper motor has three separate magnetically nisolated sections or stacks.here the rotor and stator teeths are equal.

16. What is meant by micro stepping in stepper motor.

The methods of modulating currents through stator windings so as to obtain rotation of stator magnetic field through a small angle to obtain micro stepping action is known as micro stepping.

17. What are the advantages of micro stepping?

- Improvement in resolution.
- Dc motor like performance

- Elimination of mid frequency resonance
- Rapid motion at micro stepping rate.

PART-B

1. Explain the construction and various modes of excitation of VR stepper motor. (16)
2. Explain the construction and various modes of excitation of PM stepper motor. (16)
3. Explain the construction and working principle of Hybrid Stepper motor. (16)
4. State and explain the static and dynamic characteristics of a stepper motor. (16)
5. Explain in detail about different types of power drive circuits for stepper motor. (16)
6. Explain the mechanism of torque production in VR stepper motor. (16)
7. Draw any two drive circuits for stepper motor. (16)

SHORT QUESTIONS AND ANSWERS

Unit-III -
Switched reluctance motor

1. What is srm?

It is a doubly salient , single excited motor.this means that it has salient poles on both rotor and the stator.but only one member carries winding.the rotor has no windings,magnets or case windings.

2. What are the advantages od SRM?

- Construction is very simple
- Rotor carries no winding
- No brushes and requires less maintenance

3. What are the disadvantages of SRM?

- It requires a position sensor
- Stator phase winding shold be capable of carrying magnetizing currents
-

4. Why rotor position sensor is essential for the operation of switched reluctance motor?

It is necessary to use a rotor position sensor for commutation and speed feedback. The turning on and off operation of the various devices of power semiconductor switching circuit are influenced by signals obtained from rotor position sensor.

5. What are the different power controllers used for the control of SRM?

- Using two power semi conductors and two diodes per phase
- Phase windings and bifilar wires
- Dump – C converter
- Split power supply converter

6. What are the applications of SRM?

- Washing machines
- Fans
- Robotic control applications
- Vacuum cleaner
- Future auto mobile applications

7. What are the two types of current control techniques?

- Hysteresis type control
- PWM type control

8. What is meant by energy ratio?

Energy ratio = Wm/(Wm+R)=0.45

Wm=mechanical energy transformed

This energy cannot be called as efficiency. As the stored energy R is not wasted as a

loss but it is feedback to the source through feedback diodes.

9. Write the torque equation of SRM?

$T=1/2(i^2 dL/d\theta)$

10. What is phae winding?

Ststor poles carrying field coils.the field coils of opposite poles are connected in series such that mmf „s are additive and they are called „"phase winding"" of SRM.

11. Write the characteristics of SRM.

- Lowest construction complexity, many stamped metal elements
- Like a BLDC or stepper without the magnets
- High reliability (no brush wear), failsafe for Inverter but...acoustically noisy
- High efficiency

12. Write the voltage,power range of SRM.

Industrial

Voltage	Motor Power	Speed Range
100 - 240 Vac	50W - 10'sKW	0 - 60,000 RPM

Automotive

Voltage	Motor Power	Speed Range
12 - 42Vdc	50W -1kW	0 - 20,000 RPM

13. Define the control system of SRM.

The control system is responsible for giving the required sequential pulses to the power circuitry in order to activate the phases as required. There are two options for producing the sequence including a microcontroller to produce the signal or a timer circuit which could also produce the desired signal

14. What are the major advantages of frequency control of SRM?

This has a major advantage of being easily controlled and changed at any point by simply altering the programming. By using this method the development time is reduced and the number of modules to implement is also reduced.

15. Define the power circuitry of SRM.

- The most common approach to the powering of a switched reluctance motor is to use an asymmetric bridge converter.
- There are 3 phases in this in an asymmetric bridge converter corresponding to the phases of the switched reluctance motor. If both of the power switches either side of the phase are turned on, then that corresponding phase shall be actuated. Once the current has risen above the set value, the switch shall turn off. The energy now stored within the motor winding shall now maintain the current in the same direction until that energy is depleted.
- N+1 Switch And Diode

- This basic circuitry may be altered so that fewer components are required although the circuit shall perform the same action. This efficient circuit is known as the (n+1) switch and diode configuration.
- A capacitor can be added to either configuration, and is used to address noise issues by ensuring that the switching of the power switches shall not cause fluctuations in the supply voltage.

16. What are the current control schemes?

- Hysteresis type current regulator
- PWM type current regulator

PART – B

1. Explain the construction and working principle of switched reluctance motor. (16)
2. Describe the various power controller circuits applicable to switched reluctance motor and explain the operation of any one scheme with suitable circuit diagram. (16)
3. Draw a schematic diagram and explain the operation of a „C" dump
Converter used for the control of SRM. (16)
4. Derive the torque equation of SRM. (16)
5. Draw and explain the general torque-speed characteristics of SRM and discuss the type of control strategy used for different regions of the curve. Sketch the typical phase current waveforms of low speed operation. (16)
6. Describe the hysteresis type and PWM type current regulator for one phase of a SRM. (16)

SHORT QUESTIONS AND ANSWERS

UNIT -4 -
PERMANENT MAGNETS AND BRUSHLESS DC MOTORS

1. what are the advantages of brushless dc motors drives?

- ✓ Regenerative braking is possible
- ✓ Speed can be easily controllable

2. what are the disadvantages of brushless dc motors drives?

- ✓ It requires a rotor position sensor
- ✓ It requires a power semiconductor switching circuits.

3. Define mechanical commutators?

Its arrangement is located in the rotor
No of commutators segments are very high .

4.Define electronic commutators?

- ✓ Its arrangement is located in the stator
- ✓ No of switching devices limited to six

5.mention some applications of PMBL DC motor?

- ✓ Power alternators
- ✓ Automotive applications
- ✓ Computer and Robotics applications
- ✓ Textile and Glass industries

6.what are conventional Dc motor?

- ✓ Field magents on the stator
- ✓ Maintenance is high

7.what are PMBL DC motor?

- ✓ Field magents on the rotor
- ✓ Low maintanace

8.why is the PMBLDC motor called electronically commulated motor?

The PMBL DC motor is also called electronically commutated motor because the phase windings of PLMBL DC motor is energized by using power semiconductor switching circuits.here the power semiconductor switching circuits act as a commutator.

9.what are the classification of BLPM DC motor?

- ✓ BLPM square wave motor
- ✓ BLPM sine wave motor

10.what are the two types of BLPM SQW DC motor?

- ✓ 180”polerarc BLPM SQW motor
- ✓ 120”polearc BLPM SQW motor

11. what are the two types of rotor position sensors?

- ✓ Optical position sensor
- ✓ Hall effect position sensor

12. what are the materials used for making Hall IC pallet?

- ✓ Indiem-antinomy
- ✓ Gallium-arsenide

14. what are the classification of BLPM dc motor?

- ✓ One phase winding and one pulse BLPM dc motor
- ✓ One phase winding and two pulse BLPM dc motor
- ✓ Two phase winding and two pulse BLPM dc motor
- ✓ Three phase winding and three pulse BLPM dc motor
- ✓ Three phase windings and six pulse circuits

15. what are the features of one phase winding and one pulse BLPM dc motor?

- ✓ It is inertia should be high,such that rotor rotates continuously
- ✓ Utilization of transistor and windings are less

16. what are the features of one phase winding and two pulse BLPM dc motor?

- ✓ In this case winding utilization is better,however transistor utilization is less.
- ✓ Torque developed is more uniform

17. what are the features of two phase winding and two pulse BLPM dc motor?

- ✓ Winding utilization is only 50%which is less
- ✓ It provide better torque waveforms
- ✓

18. what are the features of three phase windings and 6 pluse circuits?

- ✓ Utilization factor of winding will be better
- ✓ Torque pulse and ripple frequency components are less
- ✓

21. what is meant by self control?

Self control ensures that for all opearating points the armature and rotor fields move exactly at the same speed.

22. what is meant by vector control?

PMSm are employed for variable speed applications. The process of controlling voltage and frequency to get the desired speed and torque is known as vector control of PMSM

PART – B

1. Sketch the structure of controller for PMBLDC motor and explain the functions of various blocks. (16)
2. Explain the closed loop control scheme of a permanent magnet brushless dc motor drive with a suitable schematic diagram. (16)
3. Drive the expressions for the emf and torque of a PMBLDC motor. (16)
4. Draw the diagram of electronic Commutator. Explain the operation of electronic Commutator. (16)
5. Discuss the use of Hall sensors for position sensing in PMBLDC motor. (16)
6. Sketch the torque-speed characteristics of a PMBLDC motor. (16)

UNIT -5
PERMANENT MAGNETS AND SYNCHRONOUS MOTORS

1. Define stator?

Stator is made up of silicon steel stampings.stator slots carry a balanced 3phasearmature winding, wound for a specified even number of poles.The ends of the armature windings are connected to the terminals of the motor.

2. Define rotor?

Rotor is made up of forged steel with outward projected poles.The number of rotor poles must be same as that of stator.These rotor poles carry field coils.They aare suitably connected to form a field winding.The ends of the field windings are connected to the two slip rings which are also mounted on to the same shaft.

3. what are merits of 3phase BLPM synchronous motor?

- It runs at a constant speed.
- No sliding contacts so it requires less maintenance.

4. what are the demerits of 3 phase BLMP synchronous motor?

Power factor of operation cannot be controlled as field current can‟t be controlled.

5. what are the rotor configurations?

- Peripheral
- Interior
- Claw-pole or Lundell

6. what are the advantages of load commutation?

- It does not require commutation circuits
- Frequency of operation can be Transverse higher

7. what are the applications of load commutation?

Some prominent applications of this drive are high speed and high power drives for compressors,blowers,conveyers,steelrolling.

8. what are advantages of synchronous motor?

- Four quadrant operation with regenerative braking is possible
- High power ratings(up to 100MW)and run at high speeds(6000rpm)

9. what are the applications of synchronous drive?

- High speed and high power drives for compressors,blowers,fans,pumps,aircraft test facilities.

10. What are the features of permanent magnet synchronous motor?

- Robust, compact and less weight
- High efficiency

11. What are the advantages of load commutation?

- It does not require commutation circuits
- Frequency of operation can be higher

12. What are the applications of PMSM?

- Used as a direct drive traction motor
- Used as high speed and high power drives forcompressors, blowers, conveyors

13. What are features of closed-loop speed control of load commutated inverter fed synchronous motor drive?

- High efficiency
- Four auadrant operation with regeneration braking is possible

14. What are the merits of PMSM?

- It runs at constant speed
- No field winding,no field loss,better efficiency

15. What are the demerits of PMSM?

Power factor of operation cannot be controlled as field winding cannot be controlled It leads to losses and decreases efficiency

16. What are assumptions made in derivation of emf equation for PMSM?

- Flux density distribution in the air gap is sinusoidal
- Armature winding consists of full pitched,concentrated similarly located coils of equal number of turns

17. Why PMSM operating in self controlled mode is known commutator less dc motor?

Load side controller performs somewhat similar function as commutator in a dc machine.The load side converter and synchronous motor combination function similar to a dc machine. First,it is fed from a dc supply and secondly like a dc machine. The stator and rotor field remain stationary with respect to each other at all speeds.Consequently,the drive consisting of load side converter and synchronous motor is known as "Commutator less dc Motor".

18. what is"pulsed mode"?

For speeds below 10%of base speed, the commutation of load side converter thyristors Is done by forcing the current through the conducting thyristors to zero This is realized by making source side converter to work as inverter each time load side converter thyristors are to be turned off since the frequency of operating of load side converter is very low compared to the source frequency. Such an operation can be realized.The operation of inverter is termed as"Pulsed mode"

19. What is load commutation?

Commutation of thyristors by induced voltages of load is known as"Load commutation".Here,frequency of operation is higher and it does not require commutation circuits.

20. What is meant bysynchronous reactance?

It is the sum of armature leakage reactance and fictitious reactance.

Xs=Xt+Xa

PART – B

1. Explain the construction and operation of PMSM. (16)
2. Explain the principle of operation of a sine wave PM synchronous machine in detail. Draw its phasor diagram and derive its torque equation. (16)
3. Derive the emf equation of PMSM. (16)
4. Write about Self control of PMSM. (16)
5. Derive the expressions for power input and torque of a PMSM. Explain how its torque speed characteristics are obtained. (16)
6. Explain in detail the vector control of permanent magnet synchronous motor. (16)