DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING

AND TECHNOLOGY

MAMALLAPURAM, CHENNAI -603104

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING QUESTION BANK

VII SEMESTER

EE6501-Power system Analysis Regulation – 2013

Academic Year 2018-19

**DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Course Code & Name : EE6703 / Special Electrical Machines

Semester / Year : VII / 2018-2019 (ODD)

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| UNIT I - SYNCHRONOUS RELUCTANCE MOTORS | | | | | | | |
| Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications. | | | | | | | |
| PART – A | | | | | | | |
| Q.No | Questions | | | | | BT Level | Competence |
| 1. | What are the applications of synchronous reluctance motors? | | | | | BTL1 | Remember |
| 2. | Draw the voltage and torque characteristics of synchronous reluctance motor. | | | | | BTL6 | Create |
| 3. | Describe the principle reluctance motor. | of | operation | of | synchronous | BTL2 | Understand |
| 4. | Compare synchronous reluctance motor and induction motor. | | | | | BTL5 | Evaluate |
| 5. | Express and explain the voltage and torque equation of synchronous reluctance motor. | | | | | BTL2 | Understand |
| 6. | Write the different types of controllers used for synchronous reluctance motor. | | | | | BTL4 | Analyze |
| 7. | Classify the different types of synchronous reluctance motor. | | | | | BTL4 | Analyze |
| 8. | List the merits of 3-phase brushless permanent magnet synchronous motor. | | | | | BTL3 | Apply |
| 9. | What are the types of rotor available in synchronous reluctance motor? | | | | | BTL1 | Remember |
| 10. | What are SYNREL motors? | | | | | BTL2 | Understand |
| 11. | Give some potential reluctance machine. | applications | | of | synchronous | BTL3 | Apply |
| 12. | Examine the various design parameters of synchronous reluctance motor. | | | | | BTL1 | Remember |
| 13. | Give the operating principle of radial flux motor. | | | | | BTL2 | Understand |
| 14. | List out any four properties of reluctance motors. | | | | | BTL1 | Remember |
| 15. | Define reluctance torque with reference to synchronous reluctance motor. | | | | | BTL1 | Remember |
| 16. | Define cogging. | | | | | BTL1 | Remember |
| 17. | Why the power factor of synchronous reluctance motor is much lower than permanent magnet motor? | | | | | BTL3 | Apply |

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| 18. | Compare synchronous reluctance motor with conventional synchronous motor. | BTL5 | Evaluate |
| 19. | Mention any two advantages of synchronous reluctance motors. | BTL4 | Analyze |
| 20. | Draw the phasor diagram of synchronous reluctance motor. | BTL6 | Create |
| PART – B | | | |
| 1. | 1. Generalize the expression for the torque equation for the synchronous reluctance motor. (7) 2. Investigate the performance of the synchronous reluctance motor with neat phasor diagram. (6) | BTL6 | Create |
| 2. | 1. Draw the phasor diagram of synchronous reluctance motor. (3) 2. Explain the construction and operation of axial and radial flux machines. Discuss the advantages and disadvantages of each construction. (10) | BTL5 | Evaluate |
| 3. | 1. Derive the torque equation of a synchronous reluctance motor and draw the torque angle characterisitcs. (7) 2. Derive the expression for d-axis synchronous reactance of a permanent magnet synchronous reluctance motor (6) | BTL2 | Understand |
| 4. | 1. Discuss the various stator current modes in a synchronous reluctance motor in detail. (7) 2. Write a detailed technical note on the variable reluctance motor and the advantages. (6) | BTL2 | Understand |
| 5. | Derive the voltage and torque equations of synchronous reluctance motor. (13) | BTL3 | Apply |
| 6. | Describe the constructional features and operation of variable reluctance synchronous reluctance motor. (13) | BTL2 | Understand |
| 7. | Explain with neat diagram, the construction, working principle and types of synchronous reluctance motor. (13) | BTL1 | Remember |
| 8. | Explain the torque speed characteristics of synchronous reluctance motor in detail. (13) | BTL1 | Remember |
| 9. | Derive the open circuit emf of synchronous reluctance motor. (13) | BTL3 | Apply |
| 10. | (i) Draw the steady state phasor diagram of synchronous reluctance motor and derive the expression for torque of synchronous reluctance motor. (13) | BTL1 | Remember |
| 11. | Differentiate between axial and radial airgap synchronous reluctance motors. Compare the performance of synchronous reluctance motor with switched reluctance motor. (13) | BTL4 | Analyze |
| 12. | Explain circle diagram and torque–speed characteristics of synchronous reluctance motor. (13) | BTL1 | Remember |
| 13. | Summarize the design considerations of synchronous reluctance motor. (13) | BTL4 | Analyze |
| 14. | 1. Discuss the main advantages and disadvantages of synchronous reluctance motor. (7) 2. Discuss the various applications of synchronous reluctance motor. (6) | BTL4 | Analyze |

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| Part - C | | | |
| 1. | A 3Ф,230 Volts,60 HZ,4 pole Star Connected Reluctance Motor has Xd=22.5Ω and Xq=3.5Ω.The Armature Resistance is negligible. The Load torque is TL=12.5Nm.The Voltage to Frequency ratio is Maintained constant at the rated value. If the Supply frequency is 50 HZ. Determine i) The Torque Angle δ ii) The Line current iii) The Input Power Factor. (15) | BTL5 | Evaluate |
| 2. | Relate the constructional features of axial and radial gap synchronous reluctance motor. (15) | BTL4 | Evaluate |
| 3. | What is saliency ratio of SynRM and how it can be improved? (15) | BTL6 | Create |
| 4. | Compare Reluctance Motor with Induction Motor and Synchronous motor. (15) | BTL6 | Create |
| UNIT II - STEPPER MOTORS | | | |
| Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop  control-Concept of lead angle – Applications. | | | |
| PART – A | | | |
| 1. | Analyze the various driver circuits used in stepped motor. | BTL4 | Analyze |
| 2. | Define stepping angle. | BTL1 | Remember |
| 3. | Name the various modes of excitation in stepping motor. | BTL4 | Analyze |
| 4. | Define the terms holding and detent torques as referred to stepper motor. | BTL1 | Remember |
| 5. | Distinguish the half step and full step operations of a stepper motor. | BTL5 | Evaluate |
| 6. | Summarize the principle of operation of a variable reluctance stepper motor. | BTL2 | Understand |
| 7. | Point out the difference between single and multi-stack stepping motors. | BTL4 | Analyze |
| 8. | Write the principle of operation of stepping motors. | BTL1 | Remember |
| 9. | Explain the features of stepper motor which are responsible for its wide spread use. | BTL5 | Evaluate |
| 10. | What is the function of drive circuit in stepping motor? | BTL1 | Remember |
| 11. | Define torque constant of a stepper motor. | BTL1 | Remember |
| 12. | Calculate the stepping angle for a 3phase, 24 pole permanent magnet stepper motor. | BTL3 | Apply |
| 13. | Mention the various applications of micro stepping VR stepper motor. | BTL2 | Understand |
| 14. | What is the need of suppressor circuits in stepper motor. | BTL3 | Apply |
| 15. | Draw the block diagram of the drive systems of a stepping motor. | BTL6 | Create |

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| 16. | Illustrate the principle of hybrid stepping motors. | BTL3 | Apply |
| 17. | What is meant by lead angle in stepper motors? | BTL2 | Understand |
| 18. | Draw the equivalent circuit of a winding in stepper motor | BTL6 | Create |
| 19. | What are the applications of the stepper motor? | BTL2 | Understand |
| 20. | Define slewing. | BTL1 | Remember |
| PART – B | | | |
| 1. | 1. Explain microprocessor based control of stepper motor with an example. (10) 2. What are the advantages of closed loop control of stepper motor? (3) | BTL1 | Remember |
| 2. | Describe the operation of variable reluctance type stepper  motor with different modes of operation. (13) | BTL1 | Remember |
| 3. | Construct and evaluate the operation of single stack and multi-stack stepper motor with a neat diagram. (13) | BTL5 | Evaluate |
| 4. | 1. Compare the static and dynamic characteristics of stepper motor with necessary diagrams. (7) 2. Explain closed loop control of stepper motor. (6) | BTL4 | Analyze |
| 5. | Discuss the construction and working principle of hybrid stepper motor with neat diagrams. (13) | BTL4 | Analyze |
| 6. | Draw and explain the drive circuits and their performance characteristics for stepper motor. (13) | BTL6 | Create |
| 7. | Discuss the following :   1. Modes of excitations of stepping motors. (7) 2. Characteristics of stepping motors. (6) | BTL2 | Understand |
| 8. | 1. Explain the mechanism of static torque production in a variable reluctance stepping motor. (10) 2. Calculate the stepping angle for a 3 phase 24 pole permanent magnet type stepper motor. (3) | BTL3 | Apply |
| 9. | With a neat block diagram explain microprocessor control  of stepping motor. (13) | BTL1 | Remember |
| 10. | 1. Discuss in detail, about the construction and working principle of Variable reluctance stepper motors. (7) 2. A single stack 3 phase variable reluctance motor has a step angle of 15˚.Find the number of stator and rotor poles. (6) | BTL2 | Understand |
| 11. | 1. What is the motor torque Tm required to accelerate an initial load of 2\*10-4 kgm2 from 500Hz to 1500Hz in   50ms. The frictional torque is 0.03Nm and step angle is1.18˚. (7)   1. Write a detailed technical note on the bipolar drives for stepper motors. (6) | BTL3 | Apply |
| 12. | 1. Explain with a neat diagram the multi-stack configuration in stepper motors. (7) 2. A stepper motor has a resolution of 180 steps per revolution. Find the pulse rate required in order to obtain a rotor speed of 2400 rpm. (6) | BTL1 | Remember |
| 13. | Discuss the principle of operations of permanent magnet stepper motor with torque Vs angle characteristics. (13) | BTL4 | Analyze |

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| 14. | Discuss dual voltage driver circuit for two phase on drive of a four phase stepper motor and explain the nature of current build up in dual voltage drive. (13) | BTL2 | Understand |
| PART – C | | | |
| 1. | A stepper motor has a step angle of 2.5, Determine, i)Resolution. ii)Number of steps per shaft to make 25 revolutions iii)Shaft speed if Starting stepping frequency is 3600pulse/sec. (15) | BTL5 | Evaluate |
| 2. | Discuss about unipolar and bipolar driver circuits of stepping motor. (15) | BTL6 | Create |
| 3. | Explain the working of single and multistack configured stepping motors. Also comment on microstepping. (15) | BTL5 | Evaluate |
| 4. | Discuss the principle of operations of permanent magnet stepper motor with torque Vs angle characteristics. (15) | BTL6 | Create |
| UNIT III - SWITCHED RELUCTANCE MOTORS (SRM) | | | |
| Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications. | | | |
| PART – A | | | |
| 1. | What is the significance of closed loop control in switched reluctance motor? | BTL1 | Remember |
| 2. | List out the advantages of switched reluctance motors. | BTL1 | Remember |
| 3. | Point out the different power controllers used for the control of switched reluctance motor. | BTL 4 | Analyze |
| 4. | Illustrate the different modes of operation of switched reluctance motor. | BTL3 | Apply |
| 5. | Compare the advantages and disadvantages of the converter circuit with two power semiconductor devices and two diodes per phase. | BTL4 | Analyze |
| 6. | Give the advantages of sensorless operation of switched reluctance motor. | BTL2 | Understand |
| 7. | Discuss the principle of operation of switched reluctance motor. | BTL2 | Understand |
| 8. | Generalize the voltage and torque equation of switched reluctance motor. | BTL6 | Create |
| 9. | Mention some position sensors in switched reluctance motor. | BTL4 | Analyze |
| 10. | Analyze why SR machines popular in adjustable speed drives. | BTL3 | Apply |
| 11. | What is the need of shaft position sensor for switched reluctance motor? | BTL2 | Understand |
| 12. | List the methods of rotor position sensing in switched reluctance motor. | BTL1 | Remember |
| 13. | Illustrate the applications of switched reluctance motor. | BTL3 | Apply |
| 14. | Define energy ratio. | BTL1 | Remember |

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| 15. | Differentiate switched reluctance motor with variable reluctance stepper motor. | BTL5 | Evaluate |
| 16. | Draw the torque speed characteristics of switched reluctance motor. | BTL6 | Create |
| 17. | Define voltage pulse width modulation control. | BTL1 | Remember |
| 18. | What is hysteresis current control? | BTL1 | Remember |
| 19. | Summarize the disadvantages switched reluctance motor. | BTL2 | Understand |
| 20. | Differentiate the merits & demerits of converter having phase winding with bifilar wires. | BTL2 | Understand |
| PART – B | | | |
| 1. | 1. Explain with a neat circuit any two configuration of power converters used for the control of switched reluctance motor. (10) 2. State the advantages of sensorless operation. (3) | BTL2 | Understand |
| 2. | Draw the cross sectional view of switched reluctance motor and explain the principle of operation. State the advantages of switched reluctance motor. (13) | BTL1 | Remember |
| 3. | 1. Along with circuit diagrams explain the hysteresis type and PWM current regulator for one phase of a switched reluctance motor. (10) 2. Explain briefly the various modes of excitation of variable reluctance motor. (3) | BTL3 | Apply |
| 4. | 1. Explain the role of microprocessors in control of switched reluctance motor. (7) 2. Derive the torque equations of the variable reluctance motor and illustrate the various dependent parameters. (6) | BTL3 | Apply |
| 5. | Summarize the steady state performance analysis of switched reluctance motor. (13) | BTL5 | Evaluate |
| 6. | Explain the closed loop control analysis of switched reluctance motor. (13) | BTL1 | Remember |
| 7. | 1. Compare and contrast the performances of SR motor and VR stepper motors. (3) 2. Explain the importance of closed loop control in SR   motor. (10) | BTL4 | Analyze |
| 8. | Discuss the following in switched reluctance motor   1. Methods of rotor position sensing (7) 2. Sensorless operation. (6) | BTL2 | Understand |
| 9. | Draw and explain four converter topologies for a three phase SRM. Write the merits and demerits of each topology. (13) | BTL1 | Remember |
| 10. | 1. Explain the torque-speed characteristics of switched reluctance motors. (7) 2. Derive the expressions for voltage and torque of SR machines. (6) | BTL6 | Create |
| 11. | Discuss the necessity of power electronic circuit in SR motor. Explain its different types of converter circuits.(13) | BTL4 | Analyze |
| 12. | 1. Explain the shaft position sensing of SR motor. (7) 2. Explain the nonlinear analysis of SRM. (6) | BTL1 | Remember |

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| 13. | Discuss the various converter topologies for a 3 phase switched reluctance motor with merits and demerits of  each. Explain any two of them. (13) | BTL2 | Understand |
| 14. | 1. Discuss the main advantages and disadvantages of switched reluctance motor. (7) 2. Discuss the various applications of switched reluctance motor. (6) | BTL4 | Analyze |
| PART – C | | | |
| 1. | Sketch the general speed-torque curve of SR motor and discuss the type of control strategy used for different regions of the curve. Sketch the typical phase current waveforms of low speed operation. (15) | BTL6 | Create |
| 2. | Compare and contrast the features of Rotary and Linear switched reluctance motors. (15) | BTL5 | Evaluate |
| 3. | Explain the closed loop control of SRM using sensorless operation. (15) | BTL5 | Evaluate |
| 4. | With a neat block diagram, describe in detail the microprocessor based controller in switched reluctance motor. (15) | BTL6 | Create |
| UNIT IV - PERMANENT MAGNET BRUSHLESS D.C. MOTORS | | | |
| Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics  – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Moto characteristics and control– Applications. | | | |
| PART – A | | | |
| 1. | List the permanent magnet materials used in PMBLDC motors. | BTL 1 | Remember |
| 2. | Compare conventional DC motor and PMBLDC motor. | BTL 4 | Analyze |
| 3. | Compare PMBLDC motor with PMSM. | BTL 5 | Evaluate |
| 4. | Define Permeance coefficient. | BTL 1 | Remember |
| 5. | Comment on demagnetization in PMBLDC motor. | BTL 4 | Analyze |
| 6. | Describe the principle of operation of PMBLDC motor. | BTL 2 | Understand |
| 7. | List out the different classifications of BLPM DC motor? | BTL 3 | Apply |
| 8. | Draw the magnetic equivalent circuit of 2 pole PMBLDC motor. | BTL 6 | Create |
| 9. | How the permanent magnet motors are named based on the wave shape of emf? | BTL 3 | Apply |
| 10. | Express the torque and Emf equation of square wave brushless motor. | BTL 2 | Understand |
| 11. | Justify the statement: PMBLDC motor is called electronically commutated motor. | BTL 5 | Evaluate |
| 12. | Compare and contrast mechanical and electronic commutator. | BTL 4 | Analyze |
| 13. | What are the merits of the brushless DC motor drives? | BTL 2 | Understand |

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| 14. | List out the power controllers used in permanent magnet brushless DC motor. | BTL 1 | Remember |
| 15. | Give short note on hall & optical sensors and its uses? | BTL 1 | Remember |
| 16. | Name the position sensors that are used for PMBLDC motor. | BTL 1 | Remember |
| 17. | How are the directions of rotations reversed in PMBLDC motor? | BTL 2 | Understand |
| 18. | Sketch the ideal phase voltage and current waveform of PMBLDC machine. | BTL 6 | Create |
| 19. | A permanent magnet DC commutator motor has a stalling torque of 2 Nm. The stall current is 5 A. Compute the motor’s no-load speed if it is fed with 28 V DC supply. | BTL 3 | Apply |
| 20. | Mention some of the applications of PMBLDC Motor. | BTL 1 | Remember |
| PART – B | | | |
| 1. | 1. Derive an expression for permeance coefficient of PMBLDC motor. (10) 2. State the advantages of BLPM DC motor over conventional DC motor. (3) | BTL2 | Understand |
| 2. | Illustrate B-H hysteresis loop of permanent magnet material. (13) | BTL3 | Apply |
| 3. | Explain the construction PMBLDC also compare conventional DC motor and PMBLDC motor. (13) | BTL1 | Remember |
| 4. | 1. Elucidate in detail about the operation of PMBLDC motor with 180˚ magnet arcs and 120˚ square-wave phase currents. (7) 2. Describe the constructional aspects of mechanical and electronic commutators of PMBLDC motors. (6) | BTL1 | Remember |
| 5. | Discuss in detail about magnetic circuit analysis of PMBLDC motor. Also draw its characteristics. (13) | BTL4 | Analyze |
| 6. | Derive the expression for emf and torque of a PMBLDC motor. Draw the relevant characteristics. (13) | BTL2 | Understand |
| 7. | Analyze the operation of electronic commutator in PMBLDC motor with necessary diagrams. Explain the operation of the same. (13) | BTL4 | Analyze |
| 8. | Write a note on power controllers used for PMBLDC motor and explain the each blocks associated in it. (13) | BTL1 | Remember |
| 9. | Discuss the hysteresis type current regulation of PMBLDC motor with neat diagram? (13) | BTL2 | Understand |
| 10. | Discuss the use of Hall sensors for position sensing in PMBLDC motor with necessary block diagram. (13) | BTL6 | Create |
| 11. | 1. Explain the speed-torque characteristics of PMBLDC motor.(7) 2. Differentiate between Mechanical and Electronic Commutators. (6) | BTL4 | Analyze |
| 12. | 1. A permanent magnet DC commutator motor has a no- load speed of 6000 rpm when connected to a 120 V supply. The armature resistance is 2. Ω and rotational and   iron losses may be neglected. Determine the speed when  the supply voltage is 60 V and the torque is 0.5 Nm. (7)   1. Prove that the torque equation in BLDC motor is similar to that of conventional DC motor. (6) | BTL5 | Evaluate |

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| 13. | 1. Explain in detail about various types of PMBLDC motor with necessary diagrams. (7) 2. A PMBLDC motor has torque constant of 0.12 Nm/A referred to DC supply. Find the motor’s no-load speed when connected to 48 V DC supply. Find the stall current and stall torque if armature resistance is   0.15 Ω/phase & drop in controller transistor is 2 V. (6) | BTL3 | Apply |
| 14. | Explain the closed loop control scheme of a PMBLDC motor drive with a suitable schematic diagram. (13) | BTL1 | Remember |
| PART – C | | | |
| 1. | Draw IGBT based inverter circuit for delta connected PMBLDC Motor and sketch the firing sequence and phase current waveform for 120˚ mode. (15) | BTL6 | Create |
| 2. | Deliberate the operation of power controllers for PMBLDC Motor with neat diagram. (15) | BTL5 | Evaluate |
| 3. | Confer in detail about the operation of an electronic commutator. (15) | BTL6 | Create |
| 4. | Convene the use of Hall sensors for position sensing in PMBLDC motors. (15) | BTL5 | Evaluate |
| UNIT V - PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) | | | |
| Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications. | | | |
| PART – A | | | |
| 1. | Compare and contrast Ideal PMSM with practical PMSM. | BTL4 | Analyze |
| 2. | List out the merits and demerits of PMSM? | BTL1 | Remember |
| 3. | State two classifications of PM synchronous machines with its associated types. | BTL3 | Apply |
| 4. | Express the torque and EMF equation of PMSM. | BTL5 | Evaluate |
| 5. | Enumerate the assumptions to be made in deriving the EMF equation of PMSM? | BTL3 | Apply |
| 6. | Briefly explain about synchronous reactance. Also write the expression for self and synchronous reactance of PMSM. | BTL6 | Create |
| 7. | Define load angle. | BTL1 | Remember |
| 8. | State the power controllers for PM synchronous machines. | BTL2 | Understand |
| 9. | Summarize load commutation? Mention its advantages. | BTL2 | Understand |
| 10. | Describe the features of closed loop speed control of loaded commuted Inverter fed synchronous motor drive? | BTL2 | Understand |
| 11. | Define pulsated mode? | BTL1 | Remember |
| 12. | Distinguish between self control and vector control PMSM. | BTL2 | Understand |

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| 13. | Explain in brief about field oriented control of PMSM? | BTL4 | Analyze |
| 14. | What is self-control in PMSM? | BTL1 | Remember |
| 15. | Clearly explain the difference between SYNREL motor and PM synchronous motor. | BTL6 | Create |
| 16. | Write the important features of permanent magnet synchronous motor. | BTL1 | Remember |
| 17. | What is meant by slot less motor? | BTL1 | Remember |
| 18. | Explain the distribution factor for PMSM. | BTL4 | Analyze |
| 19. | Examine the Volt-ampere requirements of PMSM. | BTL3 | Apply |
| 20. | List few applications of PMSM? | BTL1 | Remember |
| PART – B | | | |
| 1. | Explain the construction and working principle of operation of PMSM. (13) | BTL1 | Remember |
| 2. | For an ideal sinewave permanent magnet motor derive the torque and EMF equations. (13) | BTL3 | Apply |
| 3. | Deduce the expression for synchronous reactance of PM synchronous motor. (13) | BTL4 | Analyze |
| 4. | Describe the construction of phasor diagram of surface magnet sinewave motor. (13) | BTL3 | Apply |
| 5. | With necessary phasor diagram and circle diagram, describe the torque speed characteristics of PMSM. (13) | BTL4 | Analyze |
| 6. | Derive the expression for power input and torque of a PMSM. Explain how its torque speed characteristics are obtained. (13) | BTL4 | Analyze |
| 7. | Discuss PMBLDC and PMSM with respect to torque/ampere and KVA of converter/ kW of power to motor for 4 Pole, 3 Phase motor system. (13) | BTL6 | Create |
| 8. | Analyze and Justify, the power output of PMBLDC motor is more than PMSM for the same size. (13) | BTL5 | Evaluate |
| 9. | With necessary diagrams, discuss about various power controllers used for PMSM. (13) | BTL2 | Understand |
| 10. | 1. Discuss the current control scheme of permanent magnet synchronous motor in detail. (7) 2. Derive Self and Mutual Inductance of Permanent magnet Synchronous motor. (6) | BTL2 | Understand |
| 11. | 1. What is armature reaction. Discuss its effects on PMSM. (3) 2. Explain the concept of vector control and how it achieved in PMSM. (10) | BTL1 | Remember |
| 12. | With a neat sketch, explain the microprocessor based speed control of PMSM. (13) | BTL1 | Remember |
| 13. | 1. Discuss in detail about various rotor configurations of Permanent Magnet Synchronous machines. (6) 2. With necessary block diagram explain in detail about FOC for PMSM. (7) | BTL 2 | Understand |

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| 14. | 1. State the applications of PMSM. (3) 2. Discuss in detail about Volt-ampere requirements of PMSM. (10) | BTL 1 | Remember |
| PART – C | | | |
| 1. | Discuss self control model of PM synchronous motor with revelent diagram. (15) | BTL 4 | Analyze |
| 2. | Elucidate in detail the vector control of permanent magnet synchronous motor. (15) | BTL 5 | Evaluate |
| 3. | A three phase, four pole, brushless PM rotor has 36 stator slots. Each phase winding is made up of three coils per pole with 20 turns per coil. The coil span is seven slots. If the fundamental component of magnet flux is 1.8 Mwb.  Calculate the open circuit phase emf (Eq) at 3000 rpm.  (15) | BTL 5 | Evaluate |
| 4. | Enumerate the construction and performance of a permanent magnet synchronous motor with necessary diagrams. (15) | BTL 6 | Create |