| Question Paper Code 13221 B.E. / B.Tech DECREE EXAMINATIONS, NOV / DEC 2024 Seventh Semester BLECTRICAL and Electronics Engineering 20EEEL713 - SPECIAL ELECTRICAL MACHINES Regulations - 2020 Duration: 3 Hours Max. Marks: 100 PART - A (MCO) (20 × 1 = 20 Marks) Answer ALL Questions Marks K ⁻ Lect COI (a) Paramagnetic (b) Ferromagnetic (c) Diamagnetic (d) Non-magnetic KI COI (a) To determine the step angle (b) Ferromagnetic (c) Diamagnetic (d) Non-magnetic KI COI (a) To determine the step angle (b) Fort colosed-loop control (d) Non-magnetic KI COI (a) To synchronize the motors rotation (c) To provide feedback for closed-loop control (d) To regulate the motors speed KI COI (a) Pull stop tory phases are on and in half-step? I KI COI (a) Multi step tory phases are on and in half-step? I KI COI (a) Multich power controller for Multisty I KI COI (a) Multich power controller for Multisty I step tory phases are on and in half-step? KI COI (b) Mirights of SRM is most suitable for analysis using the Analytical Method? I KI <th></th> <th></th> <th></th> <th></th> <th></th> | | | | | | |
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| (a) Large-size SRM (b) High-speed SRM (c) Variable reluctance SRM (d) Permanent magnet SRM 6. Which power controller is commonly used in Switched Reluctance Motors (SRMs) 1 K1 CO2 to control the phase current? (a) Pulse Width Modulation (PWM) controller (b) Variable Frequency Drive (VFD) (c) Thyristor-based controller (d) On/Off switch controller (e) On/Off switch controller (f) On/Off switch controller (g) Die-cast iron (b) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on 1 K1 CO3 | 5 | Which type of SRM is most suitable for analysis using the Analytical Method? | 1 | K1 | <i>CO2</i> | |
| (c) Variable reluctance SRM (d) Permanent magnet SRM 6. Which power controller is commonly used in Switched Reluctance Motors (SRMs) 1 K1 CO2 to control the phase current? (a) Pulse Width Modulation (PWM) controller (b) Variable Frequency Drive (VFD) (c) Thyristor-based controller (d) On/Off switch controller (e) On/Off switch controller (f) On/Off switch controller (g) On/Off switch controller (h) Norff switch controller (h) Norff switch controller (h) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor (h) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (f) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution (a) Rotor (c) Both stator and rotor (d) None of the mentioned | | (a) Large-size SRM (b) High-speed SRM | | | | |
| 6. Which power controller is commonly used in Switched Reluctance Motors (SRMs) 1 K1 CO2 to control the phase current? (a) Pulse Width Modulation (PWM) controller (b) Variable Frequency Drive (VFD) (c) Thyristor-based controller (d) On/Off switch controller 7. The rotor of the switched reluctance motor consists of 1 K1 CO2 (a) Die-cast iron (b) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | (c) Variable reluctance SRM (d) Permanent magnet SRM | | | | |
| to control the phase current? (a) Pulse Width Modulation (PWM) controller (b) Variable Frequency Drive (VFD) (c) Thyristor-based controller (d) On/Off switch controller 7. The rotor of the switched reluctance motor consists of 1 (a) Die-cast iron (b) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the | 6. | Which power controller is commonly used in Switched Reluctance Motors (SRMs) | 1 | K1 | <i>CO2</i> | |
| (a) Pulse Width Modulation (PWM) controller (b) Variable Frequency Drive (VFD) (c) Thyristor-based controller (d) On/Off switch controller 7. The rotor of the switched reluctance motor consists of K1 C02 (a) Die-cast iron (b) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor K1 C02 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors K1 C03 used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on K1 C03 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | to control the phase current? | | | | |
| (b) Variable Frequency Drive (VFD) (c) Thyristor-based controller (d) On/Off switch controller 7. The rotor of the switched reluctance motor consists of 1 K1 CO2 (a) Die-cast iron (b) Squirrel cage rotor 1 K1 CO2 (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the | | (a) Pulse Width Modulation (PWM) controller | | | | |
| (c) Thyristor-based controller (d) On/Off switch controller 7. The rotor of the switched reluctance motor consists of 1 K1 CO2 (a) Die-cast iron (b) Squirrel cage rotor 1 K1 CO2 (c) Salient poles (d) Three phase winnings 8 In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned 1 | | (b) Variable Frequency Drive (VFD) | | | | |
| (d) On/Off switch controller I K1 CO2 (a) Die-cast iron (b) Squirrel cage rotor I K1 CO2 (a) Die-cast iron (b) Squirrel cage rotor I K1 CO2 (c) Salient poles (d) Three phase winnings I K1 CO2 8. In sensorless operation of an SRM, which method is used to initialize the rotor I K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors I K1 CO3 (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on I K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned I | | (c) Thyristor-based controller | | | | |
| 7. The rotor of the switched reluctance motor consists of (a) Die-cast iron (b) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors K1 CO3 used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on K1 CO3 | _ | (d) On/Off switch controller | , | V 1 | con | |
| (a) Die-cast from (b) Squirrel cage rotor (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | 7. | The rotor of the switched reluctance motor consists of | 1 | ΛI | 02 | |
| (c) Salient poles (d) Three phase winnings 8. In sensorless operation of an SRM, which method is used to initialize the rotor 1 K1 CO2 position? (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | (a) Die-cast from (b) Squirrel cage rotor | | | | |
| a) Rotor position estimation based on the initial current flow (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors <i>K1</i> CO3 is used to determine the | 8 | In sensorless operation of an SRM which method is used to initialize the rotor. | 1 | K1 | CO2 | |
| (a) Rotor position estimation based on the initial current flow (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | 0. | nosition? | | | | |
| (b) Mechanical alignment of the rotor with the stator poles (c) Estimation based on the motor's rated speed and inertia (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | (a) Rotor position estimation based on the initial current flow | | | | |
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| (d) Manual input of the rotor position during motor startup 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | (c) Estimation based on the motor's rated speed and inertia | | | | |
| 9. Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors 1 K1 CO3 is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | (d) Manual input of the rotor position during motor startup | | | | |
| is used to determine the (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | 9. | Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors | 1 | K1 | CO3 | |
| (a) Mechanical load angle (b) Torque-speed characteristics (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | is used to determine the | | | | |
| (c) Copper losses (d) Magnetic flux distribution 10. Electronic commutator is kept on 1 K1 C03 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned 1 K1 C03 | | (a) Mechanical load angle (b) Torque-speed characteristics | | | | |
| 10. Electronic commutator is kept on 1 K1 CO3 (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | (c) Copper losses (d) Magnetic flux distribution | | | | |
| (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | 10. | Electronic commutator is kept on | 1 | Kl | <i>CO3</i> | |
| | | (a) Rotor (b) stator (c) Both stator and rotor (d) None of the mentioned | | | | |
| | ., | | | | 2221 | |

| 11. | . BLPM square wave motor is classified in to | | | CO3 |
|-----|---|---|-----|-------------|
| | (a) 180 degrees pole arc (b) 120 degrees pole arc | | | |
| | (c) Both 120 and 180 pole arc (d) None of the mentioned | | | ~~~ |
| 12. | In brushless DC motor, the starting characteristic is equal to | Ι | KI | CO3 |
| | (a) Induction motor (b) Compound motor | | | |
| 12 | (c) DC series motor (d) DC shuft motor | 1 | K1 | CO4 |
| 15. | (a) Interior rotor (b) Peripheral rotor (c) Claw pole (d) Transverse rotor | 1 | 111 | 007 |
| 14. | The whole working of the PMSM depends on the between stator and the | 1 | K1 | <i>CO</i> 4 |
| | rotor with no load | | | |
| | (a) Magnetic Locking (b) Air gap | | | |
| | (c) Synchronism (d) None of the mentioned | | | |
| 15. | The electronic commutator acts as anwhose frequency is influenced by the rotor speed | 1 | Kl | <i>CO</i> 4 |
| | (a) Ideal inverter (b) Ideal converter (c) Ideal chopper (d) None of the mentioned | | | |
| 16. | Permanent magnet synchronous motors are | 1 | KI | <i>CO</i> 4 |
| | (a) Brushed ac synchronous motor (b) Brushless ac synchronous motor | | | |
| 17 | (c) Commutator synchronous motor (d) None of the mentioned For a reluctance motor, the maximum average forgue occurs when $\delta =$ | 1 | K1 | CO5 |
| 17. | (a) 45° (b) 90° (c) 0° (d) 180° | | | |
| 18. | The hysteresis motor operates on power. | 1 | K1 | CO5 |
| | (a) Single-phase (b) Two-phase (c) Three-phase (d) Four-phase | | | |
| 19. | In repulsion motor, zero torque is developed when | 1 | K1 | CO5 |
| | (a) Brush axis is 45° electrical to field axis | | | |
| | (b) Brush axis coincides with the field axis (a) Brush axis is 00^0 electrical to field axis | | | |
| | (d) Both (b) and (c) | | | |
| 20. | What is the standard form of LIM? | 1 | K1 | CO5 |
| | (a) Linear Induction Motor (b) Line Induction Motor | | | |
| | (c) Lane Induction Motor (d) Linear Internal Motor | | | |
| | $\mathbf{D}\mathbf{A}\mathbf{D}\mathbf{T}$ $\mathbf{D}(10\times2-20\mathbf{M}_{owline})$ | | | |
| | Answer ALL Questions | | | |
| 21. | Classify the different modes of excitation in a stepper motor. | 2 | K2 | C01 |
| 22. | Calculate the stepping angle of 3 phase 24 pole permanent magnet stepping motor. | 2 | K2 | CO1 |
| 23. | Outline the applications of SRM. | 2 | K2 | <i>CO2</i> |
| 24. | Classify current control techniques of SRM. | 2 | K2 | <i>CO2</i> |
| 25. | What are the differences between mechanical and electronic commutators? | 2 | K1 | CO3 |
| 26. | What are the types of permanent magnet DC motor? | | | CO3 |
| 27. | Write the emf equation of PMSM. | 2 | K2 | <i>CO</i> 4 |
| 28 | Classify the rotors available in PMSM motor. | 2 | K1 | <i>CO4</i> |
| 29 | State the basic principle of operation of synchronous reluctance motor | | | CO5 |
| 30 | What is the principle of operation of a linear induction motor? | 2 | K1 | CO5 |
| 50. | the state principle of operation of a mean induction motor. | | | |

PART - C ($6 \times 10 = 60$ Marks)

Answer ALL Questions

31. a) Discuss in detail about different types of power driver circuits for stepper 10 K2 CO1 motor.

OR

b) Explain microprocessor based control of stepper motor with a neat block ¹⁰ ^{K2} ^{CO1} diagram.

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| 32. | a) | What is the necessity of the converter circuits for switched reluctance motor? Draw and explain the different types of converter circuits in detail. | 10 | К2 | <i>CO2</i> |
|-----|-------|---|----|----|-------------|
| | b) | Enumerate the various operating modes of SRM with neat diagram. | 10 | K2 | <i>CO2</i> |
| 33. | a) | Derive the Torque and EMF equations of PMBLDC Motor. | 10 | K2 | CO3 |
| | b) | Explain the closed loop control scheme of a permanent magnet brushless dc motor drive with a suitable schematic diagram. | 10 | K2 | СО3 |
| 34. | a) | Derive the expression for power input and torque of a PMSM. Explain how its torque speed characteristics obtained. | 10 | К2 | <i>CO</i> 4 |
| | b) | OR Discuss the current control scheme of permanent magnet synchronous motor in detail. | 10 | K2 | CO4 |
| 35. | a) | Explain the construction and principle of operation of synchronous reluctance motor with neat diagrams. | 10 | K2 | CO5 |
| | b) | OR Derive the torque equation of synchronous reluctance motor | 10 | K2 | CO5 |
| | 0) | berive the torque equation of synemonous refuetance motor. | 10 | | 000 |
| 36. | a) i) | Deduce an expression for synchronous reactance of PMSM | 5 | K2 | <i>CO</i> 4 |
| | ii) | Describe the principle of operation of Repulsion Motor | 5 | K2 | CO5 |
| | | OR | | | |
| | b) i) | Explain the power controllers used in PMSM. | 5 | K2 | <i>CO</i> 4 |
| | ii) | Describe the Principle of operation of Hysteresis motor with its application. | 5 | K2 | <i>CO</i> 5 |