



M.E DEGREE EXAMINATIONS: JUNE 2017

(Regulation 2015)

Second Semester

POWER ELECTRONICS AND DRIVES

P15PET204 : Special Electrical Machines and their Controllers

COURSE OUTCOMES

CO1: Describe the construction and working of special electrical machines.

CO2: Identify the characteristics of different special electrical machines

CO3: Choose a particular electrical machine for the given requirements.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The following statements are with respect to Permanent magnet synchronous motor CO1 [K₃]

Assertion (A): The power factor of motor cannot be controlled.

Reason (R): The rotor flux is constant.

- | | |
|---|---|
| a) Both A and R are correct and R is correct explanation of A | b) Both A and R are correct and R is not correct explanation of A |
| c) A is correct but R is wrong | d) A is wrong but R is correct |

2. PMSM on vector control behaves as CO2 [K₂]

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|---------------------|--------------------------------|
| a) Induction motor | b) Separately excited DC motor |
| c) Reluctance motor | d) Stepper motor |

3. The correct sequence of displacement angles (in degrees) of 6/4 pole VR stepper motor on half step mode is CO3 [K₃]

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|---------------|---------------|
| a) 0, 30, 60 | b) 0, 15, 30 |
| c) 15, 30, 45 | d) 15, 45, 75 |

4. Matching type item with multiple choice code CO1 [K₂]

List I	List II
A. Hall sensor	i. ZCS
B. Soft switching	ii. RPS
C. Freewheeling	iii. Current regulation
D. Electronic Commutation	iv. BLDC

	A	B	C	D
a)	iii	i	ii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	ii	iv

5. **Assertion (A):** BLDC motor is a square wave motor CO2 [K₂]
Reason (R): Flux distribution in the air gap of BLDC motor is sinusoidal
- a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A
c) A is true but R is false d) A is false but R is true
6. Stepper motor drive circuit, A. Reduces the losses B. Reduces the time constant CO3 [K₂]
C. Regulates the current D. Increases the torque
- a) A and B b) A and C
c) B and C d) A and D
7. Essential components of Synchronous reluctance motor drive are CO3 [K₂]
A. RPS B. Commutator C. Inverter D. Slip rings
- a) A and B b) B and C
c) B and D d) A and C
8. The Sequence of operation of power converters of SRM 1) Conduction mode (2) CO1 [K₂]
Current Regulation mode (3) Commutation mode
- a) 1-2-3 b) 1-3-2
c) 2-3-1 d) 2-1-3
9. Torque of a synchronous reluctance motor is maximum at torque angle CO2 [K₁]
- a) 0 degree b) 45 degree
c) 60 degree d) 90 degree
10. Find the correct sequence of steady state operations in self control of PMSM CO3 [K₂]
A. Obtain motor signals B. Excite the phase windings C. Switch the inverter
- a) A-B-C b) B-A-C
c) C-B-A d) A-C-B

PART B (10 x 2 = 20 Marks)

11. Define reluctance torque. CO1 [K₂]
12. What are the types of rotor structures of Synchronous reluctance motor? CO1 [K₂]
13. Write the EMF equation of Permanent Magnet Synchronous Motor. CO2 [K₂]
14. Mention few permanent magnets. CO3 [K₁]

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|---|-----|-------------------|
| 15. Name two rotor position sensors. | CO1 | [K ₁] |
| 16. What are the classifications of brushless permanent magnet motor? | CO2 | [K ₂] |
| 17. Define synchronous reactance in PMSM. | CO2 | [K ₂] |
| 18. What is meant by self control of PMSM? | CO3 | [K ₂] |
| 19. What is the function of drive circuit in stepping motor? | CO3 | [K ₂] |
| 20. Define pull out torque of stepper motor? | CO2 | [K ₂] |

PART C (10 x 5 = 50 Marks)

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|--|-----|-------------------|
| 21. Draw and explain the torque – speed characteristics of synchronous reluctance motor. | CO2 | [K ₂] |
| 22. Draw the phasor diagram of synchronous reluctance motor | CO2 | [K ₃] |
| 23. Explain in detail about the power controllers used for Switched Reluctance Motors. | CO3 | [K ₂] |
| 24. Derive the torque equation of SRM. | CO2 | [K ₃] |
| 25. Explain the torque - speed characteristics of Permanent Magnet Synchronous Motor. | CO2 | [K ₂] |
| 26. Explain the vector control scheme of PMSM with block diagram | CO3 | [K ₃] |
| 27. Distinguish between mechanical and electronic commutators. | CO1 | [K ₂] |
| 28. Explain the principle of operation of Hall sensor. | CO1 | [K ₁] |
| 29. Draw and explain the dynamic characteristics of stepper motor | CO2 | [K ₂] |
| 30. A variable reluctance stepper motor has 8 poles in the stator and they have five teeth in each pole. If the rotor has 50 teeth, calculate the step angle and resolution. | CO3 | [K ₃] |

Answer any TWO Questions

PART D (2 x 10 = 20 Marks)

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|---|-----|-------------------|
| 31. Explain the constructional details and working principle of synchronous reluctance motor. | CO1 | [K ₂] |
| 32. Draw the structure of a controller for Permanent Magnet Brushless DC Motor and explain the functions of various blocks. | CO3 | [K ₂] |
| 33. Explain the operation of VR stepper motor and its modes. | CO2 | [K ₂] |
