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Question Paper Code : 40581

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Sixth Semester

Electrical and Electronics Engineering

EE 8601 — SOLID STATE DRIVES

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Mention any two types of load torque with suitable examples.
2. List the important factors to be considered while selecting a motor for an application.
3. Write the expression for average output voltage of a three-phase full converter.
4. A chopper operates with a period of $100 \mu\text{s}$ and ON time of $30 \mu\text{s}$. Find the duty cycle.
5. Differentiate vector control and scalar control.
6. Mention the advantages of closed-loop speed control of induction motor.
7. In case of marginal angle control of synchronous motor, which angle is being controlled?
8. What is the importance of power factor control in inverter-fed synchronous motors?
9. How the feedback controllers are varied in inner current loop and outer speed loop?
10. List the factors influencing the selection of a converter for electric motor drives.

PART B — (5 × 13 = 65 marks)

11. (a) With a neat diagram, explain how an electric drive can operate in all four quadrants. Describe applications of such systems. Adapt suitable sign conventions.

Or

- (b) Explain the concept of steady state stability of an electric drive: Derive the condition for steady state stability and discuss it with the help of a torque-speed characteristic diagram.
12. (a) Explain the operation of a single-phase fully controlled converter fed separately excited DC motor. Derive the expression for motor speed and torque.

Or

- (b) Explain the principle of operation of a chopper. Discuss time ratio control methods with diagrams and waveforms.
13. (a) (i) Explain the principle of stator voltage control for speed control of a 3-phase induction motor. Include torque-speed characteristics. (7)
- (ii) With neat sketches, explain how rotor resistance control is used to control the speed of a slip-ring induction motor. (6)

Or

- (b) Explain the slip power recovery scheme for a slip-ring induction motor. Describe the function of the rotor side converter and inverter.
14. (a) Describe the self-control scheme for a synchronous motor using rotor position sensors with neat sketches.

Or

- (b) Explain the working of a three-phase current source inverter-fed synchronous motor with neat circuit diagram and waveforms.
15. (a) With a neat block diagram, explain the closed-loop control of a DC drive using both current and speed feedback. Discuss the role of each loop.

Or

- (b) Describe the field weakening operation of a DC motor. How does it extend the speed range beyond base speed?

PART C — (1 × 15 = 15 marks)

16. (a) Derive the transfer function of armature controlled separately d.c. motor drive with inner loop p controller and outer loop PI controller.

Or

- (b) (i) A 230 V, 1200 rpm, separately excited DC motor has an armature resistance of 1.5Ω . It is fed from a single-phase fully controlled bridge converter with continuous current conduction. The AC supply is 230 V, 50 Hz. If the firing angle is 30° , calculate :

- (1) Average output voltage of the converter
- (2) Armature current
- (3) Motor speed

Assume field constant and ignore armature reaction. Take back emf constant 0.2 V/rpm.

- (ii) Explain the design of a current controller in a DC motor drive with block diagram.
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