

**Question Paper Code : 50980**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fifth/Sixth Semester

Electrical and Electronics Engineering

EE 3012 – ELECTRICAL DRIVES

(Regulations 2021)

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Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Sketch the block diagram representation of a closed-loop electric drive system.
2. Sketch the equivalent model of the motor-load system and write the expression for its fundamental torque equation.
3. Draw the speed vs torque characteristics of a separately excited DC motor drive in combined armature voltage and field control mode and indicate the modes of operation.
4. What is meant by 'time ratio control' in the control strategy of chopper-fed DC drives? Classify the types of time ratio control strategies.
5. In v/f control of induction motor drive, why the v/f ratio have to be kept constant for speed control below base speed? Justify your answer.
6. List the applications of the stator voltage control method of 3-phase induction motor drive.
7. What is the difference between true synchronous and self-synchronous modes of control of synchronous motor drives?
8. How the power factor of a synchronous motor can be controlled?
9. What parameters govern the selection of converter and power devices in phase-controlled converter-fed motor drives?
10. What is the role of the compensator in closed-loop control of electric drives?

## PART B — (5 × 13 = 65 marks)

11. (a) With speed-torque sign conventions, explain the multi-quadrantal operation of an electric drive system. Also, sketch and explain the necessary block set required for the closed-loop control of the same.

Or

- (b) Classify the motor duty cycles and explain the selection of motor by considering load and thermal variation factors.
12. (a) Explain the possible quadrantal modes of operation of a 1-phase fully-controlled converter-fed separately excited DC drive with power circuit and waveforms. Sketch its speed  $V_s$  torque and output voltage  $V_s$  firing angle characteristics and explain the same.

Or

- (b) With schematics, explain the principle of operation of four quadrant chopper fed DC drive and explain its speed  $V_s$  torque characteristics under the various operating modes.
13. (a) Explain the v/f control strategy of a 3-phase induction motor drive with power schematics and control logic. Also, sketch and infer the speed  $V_s$  torque characteristics of such a control strategy when compared with the stator voltage control method.

Or

- (b) Explain the speed and torque control loops required for closed-loop control of an electric drive system with block diagram representation.
14. (a) With the required schematic, explain the concept of margin angle control of a self-controlled synchronous motor drive along with its control strategy.

Or

- (b) Explain the control principle of the PMSM drive with schematics. Also sketch the various transformations used for the control principle and hence explain the same.
15. (a) Sketch the power schematic of a 3-phase controlled converter and derive the linearized model of the converter using the transfer function approach and explain the same.

Or

- (b) Using block diagram representation, explain the working principle and design of current control loop of a phase-controlled converter-fed DC motor drive system.

**PART C — (1 × 15 = 15 marks)**

16. (a) From the fundamentals, derive the transfer function of a separately excited DC motor coupled with the dynamic load. Hence, sketch the block diagram representation of the model and discuss the system performance under simultaneous voltage input and load torque disturbance.

**Or**

- (b) With power schematic configuration, explain the working principle and commutation sequence of a current-source induction motor drive under the forward motoring and regenerative modes of operation. Compare the performance metrics of the drive system with voltage-source induction motor drives.

