*Total No. of Questions: 22*

**Enrollment No :** _____

MEDICAPS UNIVERSITY

# Faculty of Engineering

# End Semester Examination May 2025

## EE3EL18 Electric Drives

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|---|---|---|---|---|---|
| **Programme** | : | B.Tech. | **Branch/Specialisation** | : | EE |
| **Duration** | : | 3 hours | **Maximum Marks** | : | 60 |

**Note:** *All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary. Notations and symbols have their usual meaning.*

**Section 1 (Answer all question(s))**

| | | Marks | CO | BL |
|---|---|---|---|---|
| **Q1.** | In which of the following methods energy is feedback to the source?<br>○ Dynamic braking ○ Plugging<br>◉ Regenerative braking ○ Friction braking | 1 | 1 | 1 |
| **Q2.** | Load equalization in an electric drive is achieved by using-<br>◉ A flywheel ○ A step-down transformer<br>○ A capacitor bank ○ A higher torque motor | 1 | 2 | 2 |
| **Q3.** | A fully-controlled rectifier-fed DC motor operates in which quadrants?<br>○ First quadrant only ◉ First and third quadrants<br>○ First and second quadrants ○ All four quadrants | 1 | 2 | 2 |
| **Q4.** | The main disadvantage of a half-controlled rectifier-fed DC motor drive is-<br>◉ Limited speed control range ○ Higher power factor<br>○ Poor efficiency ○ Higher cost | 1 | 1 | 1 |
| **Q5.** | In a DC-DC converter-fed motor, the average output voltage can be increased by-<br>○ Increasing the load resistance ○ Decreasing the switching frequency<br>◉ Increasing the duty cycle ○ Decreasing the input voltage | 1 | 2 | 2 |
| **Q6.** | The speed-torque characteristics of a DC-DC converter-fed separately excited DC motor are similar to-<br>○ A fixed voltage drive ◉ A constant power drive<br>○ A variable power drive ○ A synchronous motor | 1 | 2 | 2 |
| **Q7.** | In a V/f controlled induction motor, maintaining a constant voltage-to-frequency ratio helps to-<br>○ Improve power factor ○ Reduce stator losses<br>◉ Maintain constant flux ○ Increase slip | 1 | 3 | 2 |
| **Q8.** | A 3-phase induction motor rated at 400V, 50Hz is controlled using V/F method. What will be the voltage setting for 25Hz operation?<br>○ 100V ◉ 200V<br>○ 300V ○ 400V | 1 | 3 | 2 |
| **Q9.** | In a separately controlled synchronous motor, the rotor excitation is provided by-<br>○ Capacitive coupling ○ Induction from the stator<br>○ AC supply ◉ An external DC source | 1 | 5 | 1 |
| **Q10.** | The main advantage of a self-controlled synchronous motor is-<br>○ Fixed speed operation ○ Simple control system<br>○ Lower power consumption ◉ Better dynamic performance | 1 | 5 | 1 |

## Section 2 (Answer all question(s))

Marks CO BL

**Q11.** What is meant by electric drives? 2 1 1

| Rubric | Marks |
|---|---|
| Briefly explanation of electric drives. | 2 |

**Q12.** Explain the concept of load equalization in electric drives. 3 2 2

| Rubric | Marks |
|---|---|
| Reason of load fluctuations | 1 |
| Concept of load equalization | 2 |

**Q13. (a)** Describe the four quadrant operation of an electrical drive system using hoist load. 5 4 3

| Rubric | Marks |
|---|---|
| Four quadrant diagram | 2 |
| Operation explanation of four quadrants | 3 |

**(OR)**

**(b)** Derive the fundamental torque equation of an electric drive and define various load torques.

| Rubric | Marks |
|---|---|
| Derivation for torque equation for an electric drives. | 3 |
| Definition of various load torques | 2 |

## Section 3 (Answer all question(s))

Marks CO BL

**Q14.** What is a dual converter? 2 1 1

| Rubric | Marks |
|---|---|
| Brief explanation of dual converter. | 2 |

**Q15. (a)** Derive the speed-torque expression and discuss the speed-torque characteristics of a fully controlled converter-fed separately excited DC motor drive. 8 4 3

| Rubric | Marks |
|---|---|
| Derivation for speed-torque expressions. | 3 |
| Speed-torque characteristics (diagram) | 2 |
| Explanation of speed-torque characteristics | 3 |

**(OR)**

**(b)** A 200V, 900 rpm, 100 A separately excited DC motor has an armature resistance of 0.05 ohm. It is fed from a single phase fully controlled rectifier connected to AC source voltage of 220V, 50 Hz. Calculate the firing angle for rated motor torque for speed of 500 rpm. Also calculate speed of motor at rated torque with a firing angle $\alpha = 45^0$.

| Rubric | Marks |
|---|---|
| Calculate the firing angle for rated motor torque for speed of 500 rpm. | 4 |
| Calculate speed of motor at rated torque with a firing angle $\alpha = 45^0$. | 4 |

## Section 4 (Answer all question(s))

Marks CO BL

**Q16.** Differentiate between two-quadrant and four-quadrant DC-DC converter-fed DC motor drives. **3 2 2**

| Rubric | Marks |
|---|---|
| Precisely differentiate between two-quadrant and four-quadrant DC-DC converter-fed DC motor drives in 3 to 4 points. | 3 |

**Q17. (a)** Draw and explain the output voltage and current waveforms of a DC-DC converter-fed separately excited DC motor operating in continuous current mode. **7 4 3**

| Rubric | Marks |
|---|---|
| Output voltage waveforms of a DC-DC converter-fed DC motor operating in continuous current mode (diagram). | 1 |
| Explanation | 2.5 |
| Output Current waveforms of a DC-DC converter-fed DC motor operating in continuous current mode (diagram). | 1 |
| Explanation | 2.5 |

**(OR)**

**(b)** Derive the speed-torque expressions for a separately excited DC motor when fed by a DC-DC converter. How do these expressions impact motor performance?

| Rubric | Marks |
|---|---|
| Derive the speed-torque expressions for a separately excited DC motor when fed by a DC-DC converter. | 4 |
| How do these expressions impact motor performance? | 3 |

## Section 5 (Answer all question(s))

**Marks CO BL**

**Q18.** Explain the closed-loop V/f control method of an induction motor drive. **4 3 2**

| Rubric | Marks |
|---|---|
| Diagram | 2 |
| Explanation | 2 |

**Q19. (a)** Discuss the concept of static rotor resistance control in an induction motor. How does it impact motor speed and efficiency? **6 3 3**

| Rubric | Marks |
|---|---|
| Concept of static rotor resistance control in an induction motor. | 4 |
| How does it impact motor speed and efficiency? | 2 |

**(OR)**

**(b)** Explain slip power recovery schemes in induction motor drives. Compare the working of Static Scherbius and Static Kramer drives with respect to performance.

| Rubric | Marks |
|---|---|
| Explanation of slip power recovery schemes in induction motor drives. | 3 |
| Comparison between Static Scherbius and Static Kramer drives with respect to performance. | 3 |

## Section 6 (Answer any 2 question(s))

**Marks CO BL**

**Q20.** Explain the difference between separate control and self-control of a synchronous motor. **5 5 2**

| Rubric | Marks |
|---|---|
| Three difference | 3 |
| explanation of differences | 2 |

**Q21.** Describe the working of a load-commutated thyristor inverter used for synchronous motor drives. **5 5 2**

| Rubric | Marks |
|---|---|
| **diagram** | 2 |
| working | 3 |

**Q22.** With neat sketch, describe the basic operation of PMSM. **5 5 2**

| Rubric | Marks |
|---|---|
| Diagram | 2 |
| Operation | 3 |

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