

Course Outlines

Permanent Magnet Synchronous Machines

Chapter 1: Lorentz Force Law and Mathematical Basics

- Basics of Electrical Machines
- Lorentz Force Law
- Vector Operations: Cross Product and Dot Product
- Applying Vector Operations to Lorentz Force Law
- Summary and Key Takeaways

Chapter 2: Basic Experiments

- Introduction
- Pulse Width Modulation (PWM)
- DC Machine as a Motor
- DC Machine as a Generator
- 3-Phase AC Machine as a Motor
- 3-Phase AC Machine as a Generator
- Conclusion

Chapter 3: Magnetic Circuit Fundamentals

- Introduction
- Magnetic Flux & Magnetic Flux Density
- Electric Circuit Foundation
- Magnetic Circuits
- Conclusion

Chapter 4: Electromagnetic Principles

- Introduction
- Maxwell's Equations
- Ampere's Law: Motor Operation and Magnetic Field Intensity
- Faraday's Law: Generator Operation
- Flux Linkage
- Inductance
- Conclusion

Chapter 5: Derivation of Fundamental PMSM Equations

- Introduction
- Relationship between Electrical and Mechanical Values
- Rotating Magnetic Field
- Back EMF
- Torque Equation
- PMSM Complete Operation
- Conclusion

Chapter 6: Electrical Machine Materials & Non-linearities

- Introduction
- Permanent Magnets
- Electrical Steel
- Windings (Copper & Aluminium)
- Non-Linearities in Electrical Machines
- Conclusion

Chapter 7: Losses in Electrical Machines

- Introduction
- Copper Losses
- Iron Losses
- Permanent Magnet Losses
- AC Losses
- Mechanical Losses
- Overall Efficiency and Optimisation in Electrical Machines

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