

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)

B.Tech. II Year II Semester Regular & Supplementary Examinations March/April-2026

INDUCTION AND SYNCHRONOUS MACHINES

(Electrical & Electronics Engineering)

Time: 3 Hours

Max. Marks: 70

PART-A

(Answer all the Questions 10 x 2 = 20 Marks)

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|-----|---|-----|----|----|
| 1 a | What is slip in an induction motor? | CO1 | L1 | 2M |
| b | What are common applications of 3-phase induction motors? | CO1 | L1 | 2M |
| c | Why is a direct-on-line (DOL) starter used for small induction motors? | CO2 | L2 | 2M |
| d | How can the speed of a 3-phase induction motor be controlled? | CO2 | L3 | 2M |
| e | What is the main difference between crawling and cogging? | CO3 | L4 | 2M |
| f | Name two types of starting methods used in single-phase induction motors. | CO3 | L1 | 2M |
| g | What is armature reaction in a synchronous generator? | CO4 | L2 | 2M |
| h | How is the frequency of a synchronous generator related to speed and number of poles? | CO5 | L3 | 2M |
| i | Why is a damper winding used in a synchronous motor? | CO6 | L4 | 2M |
| j | What is meant by over-excitation and under-excitation in a synchronous motor? | CO6 | L2 | 2M |

PART-B

(Answer all Five Units 5 x 10 = 50 Marks)

UNIT-I

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|-----|---|-----|----|----|
| 2 a | Explain the production of rotating magnetic field in 3 phase induction motor. | CO1 | L4 | 7M |
| b | List out the applications of 3 phase induction motor. | CO1 | L1 | 3M |

OR

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| 3 a | Describe the constructional details of squirrel cage and slip ring rotor induction machines. | CO1 | L1 | 10M |
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UNIT-II

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| 4 a | What are the methods available for speed control of 3 ϕ induction machine. | CO2 | L2 | 5M |
| b | Describe V/f control method of 3 phase induction motor. | CO2 | L4 | 5M |

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| 5 a | A 3-phase induction motor is driving full load torque which is independent of speed. If line voltage drops to 90% of the rated value. Find the increase in motor copper losses. | CO2 | L5 | 5M |
| b | Explain the rotor-emf injection for speed control of three phase induction motor. | CO2 | L4 | 5M |

UNIT-III

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| 6 a | Explain the construction and operating principle of 1 ϕ induction motor. | CO3 | L1 | 10M |
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| 7 a | List out the applications of single-phase induction motor. | CO4 | L1 | 5M |
| b | A 250 W, 230V, 50Hz capacitor start motor has the following constants for the main and auxiliary windings: main winding, $Z_m=(4.5+j3.7)$ ohm. Auxiliary winding $Z_a=(9.5+j3.5)$ ohm. Determine the value of the starting capacitor that will place the main and auxiliary winding currents in quadrature at starting. | CO4 | L3 | 5M |

UNIT-IV

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| 8 a | Derive the generalized EMF equation of an Alternator from fundamentals. | CO5 | L5 | 5M |
| b | A three phase, 16 –pole synchronous generator has a resultant air gap flux of 0.06 Wb per pole. The flux is distributed sinusoidally over the pole. The stator has 2 slots per pole per phase and 4 conductors per slot are accommodated in two layers. The coil span is 1500 electrical. Calculate the phase and line induced voltages when the machine runs at 375 rpm. | CO5 | L3 | 5M |

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| 9 | Write short notes on i) distributed winding ii) concentrated winding iii) Pitch factor iv) Distribution factor with relevant derivations v) integral slot and fractional slot winding. | CO5 | L2 | 10M |
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UNIT-V

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| 10 | Explain the variation of current and power factor with excitation in synchronous motor with relevant phasor diagrams. | CO6 | L4 | 10M |
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OR

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| 11 a | An industrial plant has an average load demand of 800 kW at a pf of 0.71 lag. A synchronous motor of 400 kVA is installed for driving an additional load and improving the plant power factor. The synchronous motor load is 160 kW at an efficiency of 90%. For synchronous motor operation at rated kVA, calculate the total load kVA and the resultant pf. | CO6 | L3 | 5M |
| b | Explain the power flow diagram of Synchronous motor. | CO6 | L2 | 5M |

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