**PVP 23**

Code: 23EE3402

**II B.Tech - II Semester – Regular Examinations - MAY 2025**

# INDUCTION AND SYNCHRONOUS MACHINES
## (ELECTRICAL & ELECTRONICS ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

## PART – A

| | | BL | CO |
|---|---|---|---|
| 1.a) | Infer why the induction motor never runs at synchronous speed. | L2 | CO1 |
| 1.b) | State the reason of skewed rotor bars in 3 phase squirrel cage induction motor. | L2 | CO1 |
| 1.c) | Identify the condition for maximum torque developed in three phase induction motor. | L2 | CO2 |
| 1.d) | Write the relation of speed with respect to poles. How it is employed in speed control of induction motor? | L2 | CO2 |
| 1.e) | Identify why single phase induction motor is not a self-starting? | L2 | CO4 |
| 1.f) | List the application of a shaded pole single phase induction motor. | L2 | CO4 |
| 1.g) | List the types of synchronous machines with respect to its rotor construction. | L2 | CO3 |

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|---|---|---|---|
| 1.h) | State the conditions for connecting two alternators in parallel. | L2 | CO5 |
| 1.i) | What do mean by damper windings? Mention its function and where it is located. | L2 | CO5 |
| 1.j) | Infer the role of synchronous condenser in power system application. | L2 | CO5 |

## PART – B

| | | | BL | CO | Max. Marks |
|---|---|---|---|---|---|
| **UNIT-I** | | | | | |
| 2 | | Explain the constructional features of Squirrel cage induction motor and compare with the slip ring induction motor. | L2 | CO2 | 10 M |
| **OR** | | | | | |
| 3 | | The power input to a 3phase induction motor is 60 kW. The stator losses are 1 kW. Calculate the mechanical power developed and rotor copper loss per phase if the motor is running with a slip of 3 %. | L3 | CO2 | 10 M |
| **UNIT-II** | | | | | |
| 4 | a) | Derive the torque equation of three phase induction motor. | L3 | CO4 | 5 M |
| | b) | Interpret the V/F speed control method of induction machine. | L3 | CO4 | 5 M |
| **OR** | | | | | |
| 5 | | Predetermine the efficiency of the three phase induction machine and examine the performance parameters with the procedure to draw the circle diagram. | L4 | CO2 | 10 M |

<table>
<tr><td colspan="5">UNIT-III</td></tr>
<tr><td>6</td><td>Explain the double field revolving theory and infer the construction and working principle of single phase induction motor.</td><td>L4</td><td>CO2</td><td>10 M</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>7</td><td>Illustrate the operation of split phase and shaded pole induction machine with its characteristics.</td><td>L3</td><td>CO4</td><td>10 M</td></tr>
<tr><td colspan="5">UNIT-IV</td></tr>
<tr><td>8</td><td>Explain the construction and working principle of Synchronous generator and infer the difference between the two rotors.</td><td>L4</td><td>CO3</td><td>10 M</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>9</td><td>The following data were obtained for the OCC of a 10 MVA, 13 kV, 3 Phase, 50 Hz, Y connected synchronous generator:
<table>
<tr><td>Field current (A)</td><td>50</td><td>75</td><td>100</td><td>125</td><td>150</td><td>162.5</td><td>200</td><td>250</td><td>300</td></tr>
<tr><td>O.C voltage (kV)</td><td>6.2</td><td>8.7</td><td>10.5</td><td>11.8</td><td>12.8</td><td>13.2</td><td>14.2</td><td>15.2</td><td>15.9</td></tr>
</table>
An excitation of 100 A causes the full loads current to flow during the short circuit test. The excitation required giving the rated current at zero pf and total voltage is 290 A.<br>(i) Calculate the adjusted synchronous reactance of the machine.<br>(ii) Calculate the leakage reactance of the machine assuming the resistance to be negligible.</td><td>L4</td><td>CO5</td><td>10 M</td></tr>
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| | | | | | |
|---|---|---|---|---|---|
| | | Determine the excitation required when the machine supplies full load at 0.8 pf lagging by using the leakage reactance and drawing the MMF phasor diagram. What is the voltage regulation of the machine? Also calculate the voltage regulation for this loading using the adjusted synchronous reactance. Compare and comment upon the results. | | | |
| | | **UNIT-V** | | | |
| 10 | a) | Explain the construction and working principle of Synchronous Motor. | L4 | CO3 | 5 M |
| | b) | Explain the variation of current and power factor of a synchronous motor with excitation. | L4 | CO3 | 5 M |
| | | **OR** | | | |
| 11 | | Explain the procedure for constructing 'V' curves and Inverted 'V' curves of Synchronous motor. | L4 | CO5 | 10 M |