DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

V SEMESTER

EE6504 – Electrical Machines-II

Regulation – 2013

Academic Year 2018 – 19 (Odd)

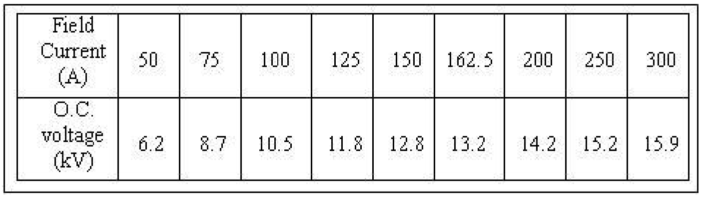
UNIT I - SYNCHRONOUS GENERATOR

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Two reaction theory –slip test - short circuit transients - Capability Curves.

PART – A

Q.No	Questions	BT Level	Competence
1.	Name the two types of large synchronous generator from their appearance.	BTL 1	Remember
2.	Distinguish between the use of salient pole and round rotor synchronous machines.	BTL 2	Understand
3.	Demonstrate why is the field system of an alternator made as a rotor?	BTL 3	Apply
4.	Differentiate between transient and sub-transient reactance	BTL 4	Analyze
5.	Describe distribution factor K_d.	BTL 1	Remember
6.	Summarize winding factors of an alternator.	BTL 5	Evaluate
7.	Explain the role of damper winding in synchronous generator.	BTL 5	Evaluate
8.	A 3MVA, 6 Pole, 50Hz alternator is supplying full load at 0.8 power factor lagging. Calculate the synchronizing torque per mechanical degree of displacement if the synchronizing power for 3 phases is 722.56 kW.	BTL 3	Apply
9.	Point out the necessity for short chording the armature winding of synchronous machines.	BTL 4	Analyze
10.	Formulate the EMF equation of an alternator.	BTL 6	Create
11.	Summarize the essential elements for generating emf in alternators.	BTL 2	Understand
12.	Develop synchronous impedance equation of an alternator.	BTL 6	Create
13.	Tell, what is meant by armature reaction in an alternator?	BTL 1	Remember
14.	Express what is meant by alternator on infinite bus-bars?	BTL 2	Understand

15.	Demonstrate the conditions to be satisfied for parallel operation of alternators.	BTL 3	Apply
16.	Define synchronizing torque.	BTL 1	Remember
17.	Explain the necessity of chording in the armature winding of synchronous machines.	BTL 4	Analyze
18.	Define voltage regulation.	BTL 1	Remember
19.	List the various methods to determine the voltage Regulation.	BTL 1	Remember
20.	Give the reason why two reaction theory is applied only to Salient pole machines.	BTL 2	Understand
PART – B			
1.	(i) Define armature reaction and explain the effect of armature reaction on different power factor loads of synchronous generators. (6)	BTL 1	Remember
	(ii) Derive the E . M . F . Equation of an alternator.		
2.	Describe a method of determining direct and quadrature axis reactance of salient pole alternator. (13)	BTL 1	Remember
3.	(i) Explain with Phasor diagrams, the capability curve of synchronous generator. (6)	BTL 4	Analyze
	(ii) A 3 Phase, 8 Pole, 750 rpm Star connected alternator as 72 slots on the armature. Each slot as 12 conductors and winding is short chorded by 2 slots. The flux per pole 0.06Wb. Find induced EMF between Lines. (7)		
4.	(i) A 3Phase star connected salient pole synchronous generator id driven at a speed near synchronous with field circuit open, the stator is supplied from balanced 3 Phase supply. Voltmeter connected across the line gave minimum and maximum readings of 2800 Volts and 2820 Volts. The Line current fluctuated between 360A and 275A. Find the direct and quadrature axis reactance per phase. Neglect armature resistance. (5)	BTL 1	Remember
	(ii) Examine the given 50kVA, Y-connected, 440V, 3-phase, 50Hz alternator, has the effective armature resistance is 0.25Ω/phase. The synchronous reactance is 3.2Ω/phase and leakage reactance is 0.5Ω/phase. Determine at rated load at unity power factor: a) Internal E.M.F. **Ea** b) no load E.M.F. **Eo** c) percentage regulation on full load d) value of synchronous reactance which replaces armature reaction. (8)		
5.	Describe the parallel operation of three phase alternators with help of a neat diagram. (13)	BTL 1	Remember
6.	(i) Sketch and explain the open-circuit and short-circuit characteristics of synchronous machines. (5)	BTL 4	Analyze
	(ii) Define the terms synchronous reactance and voltage regulation of alternator. Explain synchronous impedance method for determining regulation of an alternator. (8)		

<table>
<tr><td>7.</td><td>Predict the full load voltage regulation of a 3-phase star-connected, 1000kVA, 11,000V alternator has rated Current of 52.5A. The ac resistance of the winding per Phase is 0.45Ω. The test results are given below:
OC Test: field current = 12.5A, voltage between lines=422V
SC Test: field current = 12.5A, line current = 52.5A
(a) For 0.8 pf lagging and (b) 0.8 pf leading. (13)</td><td>BTL 2</td><td>Understand</td></tr>
<tr><td>8.</td><td>The following data were obtained for the OCC of a 10MVA, 13kV, 3-phase, 50Hz, 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 100A causes the full load current to flow during the short-circuit test. The excitation required to give the rated current at zero pf and rated voltage is 290A.
(i) Calculate the adjusted synchronous reactance of the machine.
(ii) Calculate the leakage reactance of the machine assuming the resistance to be negligible.
(iii) 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 two results. (13)</td><td>BTL 3</td><td>Apply</td></tr>
<tr><td>9.</td><td>Describe the construction and principle of operation of salient pole alternator with a neat sketch. (13)</td><td>BTL 2</td><td>Understand</td></tr>
<tr><td>10.</td><td>(i) Demonstrate the POTIER method of determining the regulation of an alternator. (5)
(ii) A 3.3kV alternator gave the following results:
<table>
<tr><td>Field current (A)</td><td>16</td><td>25</td><td>37.5</td><td>50</td><td>70</td></tr>
<tr><td>O.C. voltage (kV)</td><td>1.55</td><td>2.45</td><td>3.3</td><td>3.7</td><td>4.15</td></tr>
</table>
A field current of 18A is found to cause the full load current to flow through the winding during short circuit test. Calculate the full load voltage regulation at (a) 0.8 pf lag and (b) 0.8 pf lead by MMF method. (8)</td><td>BTL 3</td><td>Apply</td></tr>
<tr><td>11.</td><td>(i) Explain the procedure that are followed to connecting a synchronous a machine to an infinite bus bars. (6)
(ii) Explain how the direct and quadrature axis reactances of a salient pole Synchronous machines can be estimated by means of slip test (7)</td><td>BTL 4</td><td>Analyze</td></tr>
<tr><td>12.</td><td>Discuss the two reaction theory of salient pole alternator. (13)</td><td>BTL 2</td><td>Understand</td></tr>
<tr><td>13.</td><td>Generalize the EMF & MMF methods of determining the regulation of an alternator. (13)</td><td>BTL 6</td><td>Create</td></tr>
<tr><td>14.</td><td>Summarize the discussion on capability curve with its boundaries of synchronous machine. (13)</td><td>BTL 5</td><td>Evaluate</td></tr>
</table>

<table>
<tr><th colspan="4">PART – C</th></tr>
<tr><td>1.</td><td>Summarize clearly the ZPF method of determining the regulation of an alternator. (15)</td><td>BTL 5</td><td>Evaluate</td></tr>
<tr><td>2.</td><td>Generalize the Equivalent circuit and phasor diagrams of a Synchronous generator for Different power factor loading. (15)</td><td>BL 6</td><td>Create</td></tr>
<tr><td>3.</td><td>A 3 phase Y-connected, 1000 KVA, 2000V, 50HZ, alternator gave the following open-circuit and short circuit test readings:
<table>
<tr><td>I_f (A)</td><td>10</td><td>20</td><td>25</td><td>30</td><td>40</td><td>50</td></tr>
<tr><td>$V_{O.C}$ (V)</td><td>800</td><td>1500</td><td>1760</td><td>2000</td><td>2350</td><td>2600</td></tr>
<tr><td>$I_{S.C}$ (A)</td><td>-</td><td>200</td><td>250</td><td>300</td><td>-</td><td>-</td></tr>
</table>
The armature effective resistance per phase s 0.2 Ω. Draw the characteristic curves and Deduce the full load percentage regulation at (i) 0.8 p.f lagging, (i) 0.8 p.f leading by MMF method. (15)</td><td>BTL 5</td><td>Evaluate</td></tr>
<tr><td>4.</td><td>Formulate clearly the A S A method of determining the regulation of an alternator. (15)</td><td>BTL 6</td><td>Create</td></tr>
</table>

UNIT II - SYNCHRONOUS MOTOR

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed- Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

PART – A

Q.No	Questions	BT Level	Competence
1.	List the Part of Synchronous Motor.	BTL 1	Remember
2.	Show the two fundamental characteristics of a rotating magnetic field.	BTL 3	Apply
3.	Point out why synchronous motor is not a self-starting motor.	BTL 4	Analyze
4.	Convince why a synchronous motor is a constant speed	BTL 5	Evaluate
5.	Discuss how we can change the operating speed of synchronous motor.	BTL 2	Understand
6.	Discuss about 'Torque angle'.	BTL 2	Understand
7.	Develop voltage equation of synchronous motor.	BTL 6	Create
8.	Illustrate the typical torque angle characteristics of Synchronous machine.	BTL 3	Apply
9.	Define pull-out torque in synchronous motor.	BTL 1	Remember
10.	Explain V curves and inverted V curves.	BTL 5	Evaluate
11.	Tell the need for starters in synchronous motors.	BTL 1	Remember
12.	Name the starting methods of synchronous motor.	BTL 1	Remember
13.	Give any two methods of starting a synchronous motor.	BTL 2	Understand
14.	Invent what happens when the load on the synchronous motor is changed.	BTL 6	Create

15.	What should be the relationship between power angle and internal angle for stable operation of a 3 phase synchronous motor working with constant excitation? If excitation is increased, what will happen to power angle?	BTL 1	Remember
16.	Express hunting and causes of hunting.	BTL 2	Understand
17.	Explain the methods of reducing the space harmonics in a machine.	BTL 4	Analyze
18.	Demonstrate the uses of damper winding in synchronous motor.	BTL 3	Apply
19.	Explain what is meant by ‘synchronous condenser’.	BTL 4	Analyze
20.	List the inherent disadvantages of synchronous motor.	BTL 1	Remember
PART – B			
1.	(i) Tabulate the characteristic features of synchronous motor. (3)	BTL 1	Remember
	(ii) Describe how the behaviour of a synchronous motor differ from that of a 3 phase induction motor. (4)		
	(iii) Describe the reasons for the synchronous motor fails to start. (6)		
2.	(i) Show that the synchronous motor is a variable power factor motor. (7)	BTL 1	Remember
	(ii) List the advantages of salient pole in synchronous motor. (6)		
3.	Draw the simplified equivalent circuit of synchronous motor and examine the effect of loading in synchronous motor at various power factors with help of phasor diagrams. (13)	BTL 1	Remember
4.	(i) Derive the mechanical power developed per phase of a Synchronous motor. (7)	BTL 2	Understand
	(ii) Derive the expression for maximum torque developed per phase of synchronous motor. (6)		
5.	(i) Explain in detail the V curve and inverted V curve of a synchronous motor. (7)	BTL 4	Analyze
	(ii) Explain in detail the method of starting of synchronous motor. (6)		
6.	(i) Describe about the constant excitation circles and constant power circles for a synchronous motor. How they are derived? (8)	BTL 1	Remember
	(ii) A 3-phase star connected synchronous motor rated at 187kVA, 2300V, 47A, 50Hz, 187.5 rpm has an effective resistance of 1.5 ohm and a synchronous reactance of 20 ohm per phase. Determine the internal power developed by the motor when it is operating at rated current and 0.8 power factor leading. (5)		

7.	A 75 kW, 400V, 4 pole, 3 phase, star connected synchronous motor has a resistance and synchronous reactance per phase of 0.04 Ω and 0.4 Ω respectively. Compute for full load 0.8pf lead the open circuit emf per phase and gross mechanical power developed. Assume an efficiency of 92.5% (13)	BTL 4	Analyze
8.	A 6600V, 3 phase, star connected synchronous motor draws a full load current of 80A at 0.8pf leading. The armature resistance is 2.2Ω and reactance of 22Ω per phase. If the stray losses of the machine are 3200W. Find (i) EMF induced (ii) Output power (iii) Efficiency of the machine. (13)	BTL 2	Understand
9.	Discuss in detail the effect of excitation on armature current and power factor of synchronous motor. (13)	BTL 2	Understand
10.	Generalize the effect of changing field current excitation at constant load on synchronous motor. (13)	BTL 6	Create
11.	Examine in detail the effect of varying excitation on armature current and power factor of synchronous motor. (13)	BTL 3	Apply
12.	A 1000 kVA, 11000 V, 3–phase star-connected synchronous motor has an armature resistance and reactance per phase of 3.5Ω and 40 Ω respectively. Determine the induced emf and angular retardation of the rotor when fully loaded at 0.8 p.f. lagging and 0.8 p.f. leading (13)	BTL 5	Evaluate
13.	Illustrate the phenomenon of hunting and the use of damper winding with the help of dynamic equations.	BTL 3	Apply
14.	With phasor diagram illustrate how synchronous motor can be used as a synchronous condenser. (13)	BTL 4	Analyze
PART – C			
1.	Deduce the expression for power delivered by a synchronous motor in terms of load angle (α). (15)	BTL 5	Evaluate
2.	A 3300V, delta connected motor has a synchronous reactance per phase of 18 ohm. It operates at a leading power factor of 0.707 when drawing 800 kW from the mains. Calculate its excitation EMF.	BTL 5	Evaluate
3.	Formulate the power flow equations for a synchronous motor. (15)	BTL 6	Create
4.	What if, the effect of varying field current and load change on a Synchronous motor? (15)	BTL 6	Create
UNIT III - THREE PHASE INDUCTION MOTOR			
Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque– Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.			
PART – A			
Q.No	**Questions**	**BT Level**	**Competence**

1.	emonstrate why the stator core of induction motor made of silicon content steel stamping.	BTL 3	Apply
2.	Describe why the slots on the cage rotor of induction motor usually skewed are.	BTL 2	Understand
3.	Distinguish squirrel cage type rotor and phase wound rotor.	BTL 2	Understand
4.	Describe why an induction motor is called a ‘rotating transformer'.	BTL 1	Remember
5.	A 3-phase squirrel cage induction motor should not be started directly from the main supply. State reasons.	BTL 6	Create
6.	Classify the methods of starting a three phase induction motor?	BTL 4	Analyze
7.	Tell why the Induction generator is often called as Asynchronous generator.	BTL 1	Remember
8.	Describe cogging in an induction motor.	BTL 1	Remember
9.	Explain the power development stages in an induction motor.	BTL 4	Analyze
10.	Show the relationship between rotor input and rotor output in a three phase induction motor.	BTL 3	Apply
11.	Identify the condition of maximum torque developed in three phase induction motor.	BTL 1	Remember
12.	Illustrate at what value of slip does the torque developed is maximum.	BTL 3	Apply
13.	Predict how much the developed torquein an induction motor at synchronous speed is.	BTL 2	Understand
14.	Describe how do change in supply voltage and frequency affect the performance of a 3 phase induction motor.	BTL 2	Understand
15.	Generalize why staring torque of a squirrel cage induction motor cannot be altered when the applied voltage is constant.	BTL 6	Create
16.	Explain the purpose of conducting blocked rotor test.	BTL 4	Analyze
17.	Summarize the advantages of double squirrel cage induction motor?	BTL 5	Evaluate
18.	Label Slip-Torque Characteristics of double Cage Induction Motor.	BTL 1	Remember
19.	List the applications of 3-phase induction motor.	BTL 1	Remember
20.	Explain what are the measures taken for minimizing the effect of crawling in a 3 Phase Induction motor	BTL 5	Evaluate

PART – B

1.	Describe the construction and working principle of 3-phase induction motor. (13)	BTL 1	Remember
2.	(i) Distinguish between Synchronous motor and Induction motor. (5) (ii) Discuss the phenomena of Cogging or magnetic locking and Crawling in an induction motor. (8)	BTL 2	Understand

3.	(i) A 3 phase induction motor has a starting torque of 100% and a maximum torque of 200% of the full load torque. Evaluate: (1) Slip at which maximum torque occurs. (2) Full load slip. (3) Rotor current at starting in per unit of full-load rotor current. (8) (ii) Explain the construction and working principle of 3 phase induction motor. (5)	BTL 5	Evaluate
4.	(i) Explain in detail the equivalent circuit of 3 phase induction motor. (5)	BTL 4	Analyze
	(ii) A 40 kW, 3 phase slip-ring induction motor of negligible stator impedance runs at a speed of 0.96 times synchronous speed at rated torque. The slip at maximum torque is four times the full load value. If the rotor resistance of the motor is increased by 5 times, determine: (a) The speed, power output and rotor copper loss at rated torque. (b) The speed corresponding to maximum torque. (8)		
5.	Sketch and Explain the torque slip characteristics of 3 phase cage and slip-ring induction motors. Show the stable region in the graph. (13)	BTL 4	Analyze
6.	Examine the Slip when an induction motor as an efficiency of 0.9 when the shaft load is 45kW. At this load , stator ohmic loss and Rotor ohmic loss each is equal to Iron Loss. The mechanical loss is one third of the no-load losses. Neglect ohmic losses at No-Load. (13)	BTL 1	Remember
7.	Discuss the different power stages of an induction motor with losses. (13)	BTL 2	Understand
8.	A 50 HP, 6–Pole, 50 Hz, slip ring IM runs at 960 rpm on full load with a rotor current of 40 A. Allow 300 W for copper loss in S.C. and 1200 W for mechanical losses, find R_2 per phase of the 3- phase rotor. (13)	BTL 1	Remember
9.	A 100kW, 330V, 50Hz, 3 phase, star connected induction motor has a synchronous speed of 500 rpm. The full load slip is 1.8% and full load power factor 0.85. Stator copper loss is 2440W, iron loss is 3500W, and rotational losses is 1200W. Calculate (i) rotor copper loss, (ii) the line current and (iii) the full load efficiency. (13)	BTL 3	Apply
10.	(i) Point out the effect of change in supply voltage on starting torque, torque and slip. (7)	BTL 3	Apply
	(ii) Point out the effect of variation of rotor resistance and rotor reactance on maximum torque, efficiency and power factor of an induction motor. (6)		
11.	(i) Explain in detail the construction of circle diagram of an induction motor. (8)	BTL 4	Analyze
	(ii) Derive the expression for torque, slip and draw speed torque characteristics. (5)		

12.	The test readings of a 3 phase 14.71 kW,400 V, 50 Hz, star connected induction motor is given below: No load test : 400 V, 9 A, Cos θ = 0.2 Short Circuit Test: 200 V, 50 A, Cos θ =0.4. From the Circle Diagram estimate: (i) Line current (ii) Power Factor (iii) Slip (iv) Efficiency at full load. Also evaluate the maximum power output. (13)	BTL 2	Understand
13.	Describe the following: i) induction generator ii) double cage rotor induction motors. (13)	BTL 1	Remember
14.	Generalize about Synchronous-induction motor and different methods of DC excitation of rotor winding. (13)	BTL 6	Create

PART – C

1.	Explain briefly the construction and working principle of Different types of an induction motor. (15)	BTL 5	Evaluate
2.	Explain how the rotating magnetic field is produced in an induction motor. (15)	BTL 5	Evaluate
3.	Develop an equivalent circuit of 3 phase induction motor, states he difference between exact and approximate equivalent circuit. (15)	BTL 6	Create
4.	Develop the circle diagram from no-load and blocked rotor Test. (15)	BTL 6	Create

UNIT IV - STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking

PART – A

Q.No	Questions	BT Level	Competence
1.	Identify the need of starter for induction motor?	BTL 1	Remember
2.	Quote why is rotor rheostat Starters unsuited for a squirrel cage motor?	BTL 1	Remember
3.	List the advantages of DOL Starter.	BTL 1	Remember
4.	Express the relationship between staring torque and full load torque of DOL Starter?	BTL 2	Understand
5.	Illustrate Auto transformer starting of 3-phase Induction Motor.	BTL 3	Apply
6.	Describe about the star-delta starter.	BTL 1	Remember
7.	Give the typical magnitude of starting current & torque for induction motor?	BTL 2	Understand
8.	List out the methods of speed control of cage type 3 phase induction motor.	BTL 1	Remember
9.	Summarize the different methods of speed control on stator side of induction motor.	BTL 5	Evaluate

10.	Summarize the different methods of speed control from rotor side of induction motor	BTL 2	Understand
11.	Criticize “is speed control by changing the applied voltage is simpler”.	BTL 5	Evaluate
12.	Illustrate the advantages and disadvantages of V/F speed control of an induction motor	BTL 3	Apply
13.	What if “the number of poles of an induction motor Increases”.	BTL 6	Create
14.	Generalize how is super-synchronous speed achieved, while controlling the speed of an induction motor	BTL 6	Create
15.	Show the cascade connections of induction motor	BTL 3	Apply
16.	Discuss the advantages of slip power scheme. And also mention the types.	BTL 2	Understand
17.	Point out the two advantages of speed control of induction motor by injecting an e.m.f in the rotor circuit.	BTL 4	Analyze
18.	Define plugging.	BTL 1	Remember
19.	Explain Regenerative Braking and explain the condition for regenerative braking.	BTL 4	Analyze
20.	Compare Plugging, Dynamic braking and Regenerative braking.	BTL 4	Analyze
	PART – B		
1.	Discuss the various starting methods of induction motors.	BTL 1	Remember
2.	Describe why starters are necessary for starting 3-phase induction motors? Name the different types of starters and explain DOL Starter. (13)	BTL 1	Remember
3.	With neat diagrams explains the working of any two types of starters used for squirrel cage type 3 phase induction motor. (13)	BTL 4	Analyze
4.	Discuss the following starters for three phase induction motor: (i) Autotransformer starter. (ii) Star-Delta Starter. (13)	BTL 2	Understand
5.	(i) Describe a starter available for a 3-phase slip ring induction motor. (6)	BTL 2	Understand
	(ii) A small squirrel cage induction motor has a starting current of six times the full load current and a full load slip of 0.5. Estimate in pu of full-load values, the line current and starting torque with the following methods of starting ((a) to (d)). (a) Direct Switching, (b) Stator resistance starting with motor current limited to 2p.u, (c) auto-transformer starting with motor current limited to 2p.u, and (d) Y-delta starting. (e) What auto transformer ratio would give 1pu starting torque? (7)		

UNIT V – SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

PART – A

Q.No	Questions	BT Level	Competence
1.	Summarize why single phase induction motor is not self-starting. Mention any one method of starting.	BTL 5	Evaluate
2.	Discuss the double revolving field theory.	BTL 2	Understand
3.	Distinguish the terms rotating and pulsating magnetic fields.	BTL 4	Analyze
4.	Identify the inherent characteristics of plain 1-phase induction motor.	BTL 1	Remember
5.	Show the no load vector diagram for single phase induction motor.	BTL 3	Apply
6.	Develop the Speed torque characteristics of single phase induction motor.	BTL 6	Create
7.	Describe how direction of single phase Induction motor get reversed	BTL 1	Remember
8.	Examine why centrifugal switches are provided in many 1-phase induction motors.	BTL 3	Apply
9.	Design the capacitor rating required for an induction motor?	BTL 6	Create
10.	Illustrate why capacitor-start induction motors are advantageous.	BTL 3	Apply
11.	Explain how the direction of a capacitor-start motor can be reversed.	BTL 4	Analyze
12.	Describe how the direction of a capacitor run motor can be reversed.	BTL 1	Remember
13.	Summarize the advantages of capacitor start induction motor over split-phase induction motor.	BTL 2	Understand
14.	Give the limitations of shaded pole motors.	BTL 2	Understand
15.	Name the motor being used in ceiling fans.	BTL 1	Remember
16.	List the applications of single phase induction motor.	BTL 1	Remember
17.	Describe linear induction motor.	BTL 1	Remember
18.	Discuss the working principle of repulsion motor.	BTL 2	Understand
19.	Explain the principle of reluctance motor.	BTL 5	Evaluate
20.	Infer any two applications of universal motor.	BTL 4	Analyze

PART – B

1.	Give the classification of single phase motors. Explain any two types of single phase induction motors. (13)	BTL 2	Understand

2.	Using double field revolving theory, compose why a single phase induction motor is not self-starting. Also obtain the equivalent circuit of single phase induction motor with necessary equations. (13)	BTL 6	Create
3.	(i) Illustrate the operation of single phase induction motor with double field revolving theory. (7)	BTL 3	Apply
	(ii) A 220 V, 6-pole, 50 Hz, single phase induction motor has the following equivalent circuit parameters as referred to the stator. (6) R_{1m}= 3.0 Ω, X_{1m} = 5.0 Ω R_2 = 1.5 Ω, X_2 = 2.0 Ω Neglect the magnetizing current. When the motor runs at 97%of the synchronous speed, Compute the following: (i) The ratio E_{mf}/E_{mb} (ii) The ratio T_f/T_b (iii) The gross total torque.		
4.	Describe the no-load test and blocked rotor test for obtaining the equivalent circuit parameters of a single phase induction motor. (13)	BTL 1	Remember
5.	The equivalent circuit parameters of a 230 V, 50 Hz, single phase induction motor having friction, windage loss and core loss of 50 W are given below: R_{1m} = 2.4 Ω, X_{1m} = 3.2 Ω R'_2 = 4.7 Ω, X'_2 = 2.8 Ω and X_m= 90 Ω. Examine (i) Input current (ii) Power Factor (iii) Developed power (iv) Output power and (v) Efficiency for a slip of 0.04. (13)	BTL 3	Apply
6.	The equivalent impedance of the main and auxiliary winding in a capacitor motor are (15+j25)Ω and (50+ j120)Ω respectively, while the capacitance of the capacitor is 12 μ F. Estimate the line current at starting a 230 V, 50Hz supply. (13)	BTL 2	Understand
7.	(i) Explain in detail the operation of capacitor start and run induction motor. (7)	BTL 4	Analyze
	(ii) Explain how the Equivalent circuit parameter of a single induction motor determined experimentally. (6)		
8.	Explain the working of linear induction motor and also write its applications. (13)	BTL 5	Evaluate
9.	Describe briefly about the Repulsion motor. (13)	BTL 1	Remember
10.	Discuss the construction, operation and characteristics of the following: (i) Repulsion motor. (7) (ii) Servo motor. (6)	BTL 2	Understand
11.	Explain briefly the following: (i) Linear induction motor. (7) (ii) AC Series motor. (6)	BTL 4	Analyze

12.	(i) Describe what kind of modifications have to be done on a DC series motor to make it to work with single phase AC supply. State the applications of AC series motors. (6) (ii) Describe the constructional details, principle of operation and the application of Hysteresis motor. (7)	BTL 1	Remember
13.	Describe the construction and working principle of the following special machines: (i) Stepper motors. (7) (ii) Shaded pole induction motor. (6)	BTL 1	Remember
14.	(i) Explain the theory of brushless DC Machines. (7) (ii) Write short notes on Stepper Motor. (6)	BTL 4	Analyze
	PART – C		
1.	Summarize the constructional details, principle of operation and the application of Hysteresis motor and AC Series motor. (15)	BTL 5	Evaluate
2.	Explain briefly the determination of Steady state Equivalent Circuit parameters of Single Phase Induction Motor from No-load and Blocked Rotor Tests. (15)	BTL 5	Evaluate
3.	Generalize about Magnetic Levitation Systems. (15)	BTL 6	Create
4.	A 220 V, single phase induction motor gave the following test results: Blocked rotor test: 120V, 9.6 A, 460 W; No-load test: 220V, 4.6 A, 125 W. The Stator winding resistance is 1.5 Ω, and during the blocked rotor test, the starting winding is open. Prepare the Equivalent circuit parameters, core, friction and windage losses. (15)	BTL 6	Create