B **B4B101** **Pages: 2**

Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2017

EE 202 SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100 Duration: 3hours

PART A

Answer all questions. 5 marks each.

1. Write any four advantages of short pitched winding in alternators.
2. Explain the ASA method of determining voltage regulation of alternator.
3. Describe how synchronisation can be achieved using a synchroscope.
4. Draw the phasor diagram of a three phase Induction Motor at standstill and when operating at a Full load slip,'s'
5. What is meant by cogging in three phase Induction motor? How can it be eliminated?
6. Design a three step starter for a three phase,400V wound rotor Induction motor. Full Load slip is 3% and maximum starting current is limited to full load value. Rotor resistance per phase is 0.015 Ω.
7. Compare the operation of Induction generator and synchronous generator.
8. Explain the principle of operation of Synchronous Induction motor.

PART B

Answer any two questions.10 marks each.

Graph sheet permitted.

9. Derive from the fundamentals, generalised equation of the EMF generated in a non salient pole synchronous generator, taking into account the effect of 5^{th} and 7^{th} harmonic components. (10)
10. Explain the effect of armature flux on main field flux when an alternator is operating at
    (i) Lagging pf
    (ii) Unity pf.
    State the reason of accounting the effect of armature reaction as a fictitious reactance in calculations. (10)

11. A 3phase, 6000V star connected alternator has the following OCC at normal speed.

Field Ampere (A)	14	18	23	30	43
Terminal voltage (V)	4000	5000	6000	7000	8000

With armature short circuited and full load current flowing, the field current is 17A and

when the machine is supplying full load of 20000kVA at zpf, the field current is 42.5A and terminal voltage is 6000V. Determine the field current required when the machine is supplying full load at 0.8pf lagging. (10)

PART C

Answer any two questions.

12. A salient pole alternator has direct and quadrature axis reactances of 80% and 60% respectively. It is having a resistance of 10%. Determine its regulation if the generator delivers (i) Full load at rated terminal voltage and 0.8 pf lagging (ii) ¾ th Full load and 0.8pf lagging. (10)
13. With the help of a phasor diagram explain the parallel operation of alternators under no load and loaded condition. (10)
14. Derive the expression for the mechanical power developed in a 3 phase Induction motor Draw the approximate equivalent circuit also. (10)

PART D

Answer any two questions.

15. A 2.4 kW, 400V, 50Hz, 3phase, delta connected slip ring Induction motor has a stator resiatnce of 0.36Ω/phase and a rotor resistance of 0.06Ω/phase. Stator to rotor turns ratio is 2.

    No Load test data : 400V, 3.2A, Cos Φ_0=0.17

    Blocked rotor test : 210V, 16A, Cos Φ_s=0.35.

    Draw the circle diagram and find line current, pf, efficiency at Full load and maximum torque. (10)
16. a) With the help of a neat diagram, explain how an Induction motor can be started using a star delta starter. (5)

    b) Determine approximately the starting torque of an Induction motor in terms of full load torque when started by means of (i) Star delta starter (ii) Auto transformer with 50% tapping. Ignore I_μ. The short circuit current of motor at normal voltage is 5 times the full load current and slip at FL is 5%. (5)
17. Explain the following starting methods of a single phase Induction motor.

    (i) Split phase starting

    (ii)Capacitor start- capacitor run starting (10)

****

Total Pages: 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each carries 5 marks.

1 Enumerate various methods for minimising harmonics in alternators. (5)

2 What are the different methods of finding the voltage regulation of an alternator. (5)

3 Describe the slip test method for finding the X_d and X_q of synchronous machines. (5)

4 Explain the constructional details of a synchronous motor. (5)

5 Differentiate between the phenomenon cogging and crawling of an induction motor. (5)

6 List the various methods adopted for braking of an induction motor. (5)

7 Compare induction generator with synchronous generator. (5)

8 With a sketch describe the principle of working of a shaded pole motor. (5)

PART B

Answer any two questions. Each carries 10 marks.

9 a) Explain various types of armature winding of an alternator. (5)

b) Find the distribution and pitch factor of a 3Φ, 4 pole, 24 slots alternator having its armature coils short pitched by one slot. (5)

10 A 0.5 MVA, 1.1KV, 50 Hz, 3Φ, star connected alternator has R_a and X_s per phase as 0.1Ω and 1.5Ω respectively. Find its voltage regulation at different power factor of (i) unity (ii) 0.9 lag and (iii) 0.8 lead at full load. (10)

11 A 220V, 6 pole, 50 Hz, star connected alternator gave the following test results: - (10)

Field current in A	0.2	0.4	0.6	0.8	1	1.2	1.4	1.8	2.2	2.6	3	3.4
Open circuit line voltage in Volts	29	58	87	116	146	172	194	232	261	284	300	310
ZPF test line voltage in volts	-	-	-	-	-	0	29	88	140	177	208	230
SCC in A	6.6	13.2	20	26.5	32.4	40	46.3	59				

Find % voltage regulation at full load current of 40A at power factor 0.8 lag by (i) m.m.f method (ii)ZPF method. R_a=0.06 Ω /phase.

PART C

Answer any two questions. Each carries 10 marks.

12 Explain the two reaction theory of salient pole alternator. (10)

13 a) Describe the constructional features of 3Φ slip ring induction motor. (5)

b) A 6 pole, 50 Hz, 3Φ, slip ring induction motor, the rotor resistance and the reactance at stand still per phase are 0.3 and 1.5 Ω respectively. The e.m.f between the slip rings on open circuit is 175V. Calculate (i) Slip (ii) rotor e.m.f/phase (iii) rotor frequency and reactance when the motor runs at a speed of 950 r.p.m. (5)

14 a) What are the various methods of synchronisation of alternators. (5)

b) Explain the effect of excitation on armature current and power factor of a synchronous motor and hence deduce the V and inverted V curves. (5)

PART D

Answer any two questions. Each carries 10 marks.

15 a) What are the different types of starters used for starting a 3Φ induction motor. (5)

b) A 3Φ induction motor has a short circuit current 5 times of full load current at 5% slip. Determine the starting torque and starting current if the impressed voltage is reduced to 60% of the normal voltage by using starting resistance starter. The full load current and torque are 10 A and 10 Nm respectively. (5)

16 a) Explain the principle of operation of an induction generator. (10)

b) Describe the double field revolving theory of a 1 Φ induction motor. (5)

17 a) Draw the circle diagram of a 3Φ, 20 hp,400V,50Hz star connected induction motor with the following test data: - (5)

No load test	400V	9A	cos Φ=0.2
block rotor test	200V	50A	cos Φ=0.4

Stator and rotor copper losses are divided equally in the block rotor test.

b) From the above circle diagram obtain (a) line current (b) power factor (c) slip (d) efficiency at full load. (5)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1		Two alternators run on the same shaft (i.e, runs at same speed). One generates voltage at 50 Hz and the other at 40 Hz. Find the maximum possible speed. Also find another possible speed.	(5)
2		Draw the phasor diagram of cylindrical rotor alternator supplying leading current and develop an expression for induced emf E.	(5)
3		The excitation of an alternator is running on an infinite bus is steadily increased from a small value over a wide range keeping the power output constant. By drawing phasor diagram show the magnitude armature current decreases to a minimum value and then increases.	(5)
4		In rice/flour mills driven by squirrel cage induction motors, the hopper is loaded with the grains only after starting the motor. Similarly, the delivery valve of centrifugal pumps driven by squirrel cage induction motor is opened only after starting the motor. What is the reason behind this? Justify your answer with a relevant performance curve of squirrel cage induction motor.	(5)
5		No load and blocked rotor tests on induction motor are effectively open circuit and short circuit tests. Justify.	(5)
6		Name the induction motor used to drive lifts. What property of this makes it suitable to drive lifts? How this property is achieved.	(5)
7		Using equivalent circuit justify that induction machine becomes a generator when the machine is driven above synchronous speed.	(5)
8		Show the construction of one pole of a shaded pole induction motor and explain how it produces a sweeping flux when an alternating current flow through the winding.	(5)

PART B

Answer any two full questions, each carries 10 marks.

9		The armature of 60Hz 11kV 450 rpm star connected alternator has 8 conductors per slot. The winding is short chorded by 3 slots to eliminate 5^{th} harmonics completely. Find the flux per pole to generate rated voltage on open circuit.	(10)
10	a)	Prove that even harmonics will not be present in a full pitched winding.	(5)
	b)	Give the procedure for experimental determination of synchronous impedence.	(5)
11		In an alternator a field current of I amp was required to drive rated current on short circuit and a field current of 2.5 times I was required to develop rated voltage on open circuit. Using emf method find the voltage regulation of the alternator when delivering rated current at 0.8 pf lag. Assume armature resistance	(10)

= 20% of synchronous impedence. (You can assume any value for rated voltage and rated current. The final answer will be the same).

PART C

Answer any two full questions, each carries 10 marks.

12		Two 100 MW alternators operate in parallel. At no load both machines operate at 50Hz. The maximum load that can be shared without overloading either of the machines is 180 MW and this happens at 48 Hz. Find how will they share a total load of 160 MW.	(10)
13	a)	Draw the phasor diagram of a salient pole alternator working at lagging power factor and derive an expression for internal power factor angle ψ.	(5)
	b)	From rotor equivalent circuit of an induction motor derive the expression for torque in synchronous watts.	(5)
14		While running at 1440 rpm a 3-ph. induction motor draws 50 kW from the mains. The stator iron and copper losses amount to 2 kW. Find the rotor copper loss, torque in synchronous watts as well as in Newton Metre. If there is a mechanical loss of 1.08 kW, find the overall efficiency of the motor.	(10)

PART D

Answer any two full questions, each carries 10 marks.

15		A 400V 50Hz 7.5A 10HP delta connected induction motor was drawing 3A and 540W on no load test. In blocked rotor test rated current was driven with 100V and the power consumed was 450W. Draw the circle diagram and locate the maximum output point on the diagram. Find out slip efficiency and torque in synchronous watts at this point.	(10)
16	a)	Draw the schematic diagram of a star-delta starter.	(5)
	b)	Explain the working of synchronous induction motor.	(5)
17		Show that the magnetic field produced by a single-phase armature can be modelled asdouble revolving field. By drawing torque speed characteristics prove that a single-phase induction motor is not self-starting.	(10)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

(Graph sheets may be supplied)

1 Compare salient pole & cylindrical rotor type of alternators. (5)

2 What is armature reaction? Explain the effects of armature reaction in an alternator. (5)

3 Draw the phasor diagram of a salient pole alternator working at a lagging power factor and derive an expression for the regulation. (5)

4 Sketch and explain the V and inverted V- curves of a synchronous motor. (5)

5 What is the need for starter in a 3-Φ induction motor? Explain the principle of operation of a star – delta starter. (5)

6 Sketch the equivalent circuit of a double cage induction motor and explain the parameters. (5)

7 Explain the principle of operation of synchronous induction motor. What are its advantages over synchronous motors? (5)

8 Why is a 1-Φ induction motor not self starting? How is it made self starting? (5)

PART B

Answer any twofull questions, each carries 10 marks.

9 a) Define pitch factor and distribution factor as related to an ac winding. Derive expressions for both. (4)

b) A 3-Φ, 10 pole alternator has 2 slots/ pole/ phase on its stator with 10 conductors per slot. The air gap flux is sinusoidally distributed and equals 0.05 Wb. The stator has a double layer winding with a coil span of 150^{o}E. If the alternator is running at 600 rpm, calculate the emf generated /phase at no load. (6)

10 a) The following data pertains to a 5000kVA, 6600 V, 3-Φ, 50 Hz star connected alternator. (10)

Field current	32	50	75	100	140
OC voltage	3100	4900	6600	7500	8300
ZPF voltage (line) (full load)	0	1850	4250	5800	7000

Determine the regulation by ZPF method at full load unity power factor. Neglect

armature resistance. Draw its phasor diagram also.

11 a) How do harmonics affect the emf generated in an alternator? What are the techniques used to minimise these harmonic voltages in the induced emf? (4)

b) A 3-Φ, 10 kVA, 400 V, 50 Hz, star connected alternator supplies the rated load at 0.8 pf lag. If the armature resistance is 0.5Ω and synchronous reactance is 10Ω, find the load angle and voltage regulation. (6)

PART C

Answer any twofull questions, each carries 10 marks.

12 a) Explain the procedure for conduct of slip test using a neat circuit diagram. (4)

b) The efficiency of a 3-Φ, 400 V, star connected synchronous motor is 95 % and it takes 24A at full load, upf. What will be the induced emf and mechanical power developed at full load, 0.9 pf lead. The synchronous reactance is (0.2+ j2)Ω. (6)

13 a) Describe with the help of a neat circuit diagram, the two bright and one dark lamp method of synchronising an alternator to the AC mains. (4)

b) A 6-pole, 50 Hz,3-Φ induction motor running on full load develops a useful torque of 150 Nm at a rotor frequency of 1.5 Hz. Calculate the shaft power output. If the mechanical torque lost in friction is 10 Nm, determine a) rotor copper loss b) input to the motor c) the efficiency. The total stator loss is 700 W. (6)

14 a) Describe a set of torque slip characteristics of a 3-Φ induction motor. Explain the effect of change in rotor resistance on the characteristics. (4)

b) Two 3-Φ, 6.6 kV star connected alternators supply a load of 3000kW at 0.8 pf lag. The synchronous impedance/phase of machine A is 0.5 + j 10 Ω and that of machine B is 0.4 +j12 Ω. The excitation of machine A is adjusted so that it delivers 150 A at a lagging power factor and the governors are so set that the load is equally shared between the machines. Determine the current, power factor and induced emf of each machine. (6)

PART D

Answer any two full questions, each carries 10 marks.

15 a) What is "Crawling" in induction motors? What are its causes and how can it be eliminated? (5)

b) Draw the equivalent circuit of a 1-Φ induction motor and explain how it is used to predetermine the performance of the machine. (5)

16 a) A 3-Φ, 400 V, 14.91 kW induction motor gave the following test results. (6)

NL test : 400 V, 1250 W, 9A.

BR test : 150 V, 4000 W, 38 A.

Draw the circle diagram and determine the full load current, power factor, slip and efficiency.

b) With a neat diagram, explain the capacitor start and run type of induction motor. (4)

17 a) Describe the principle of operation of an induction generator. Compare grid connected and self excited type of induction generators. (5)

b) Describe any two methods of speed control of a 3-Φ induction motor. (5)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100 ***Graph sheets shall be provided.*** Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1		Derive the emf equation of an alternator.	(5)
2		Draw the phasor diagram of a cylindrical rotor type alternator with a) unity power factor load and (b) leading power factor load	(5)
3		Write the necessary conditions for synchronization of alternators.	(5)
4		Synchronous motor is not self starting. Why?	(5)
5		What is crawling in induction motor? How it can be eliminated?	(5)
6		Explain V/f speed control method in 3 phase induction motor.	(5)
7		Explain the working principle of synchronous induction motor?	(5)
8		Why single-phase induction motor is not self-starting? Also draw its torque - slip curve?	(5)

PART B

Answer any two full questions, each carries 10 marks.

9	a)	Compare salient pole alternator with smooth cylindrical alternator?	(4)
	b)	A 3-phase, 8 pole, 750rpm, star connected alternator has 72 slots on armature. Each slot has 12 conductors and winding is short pitched by two slots. Find the induced emf between the lines , given flux per pole 0.06 Wb.	(6)
10		Following test results are obtained on a 6600V alternator	(10)

Open circuit voltage in volts	3100	4900	6600	7500	8300
Field currents in Amperes	16	25	37.5	50	70

A field current of 20A is found to circulate full load current on armature with short circuited. Calculate full load regulation at 0.8 pf lag by using mmf method. Neglect armature resistance.

11	a)	Explain the causes of harmonics in alternators? How it can be eliminated?	(5)

b) A 3-phase star connected alternator supplies a load of 1000kW at a pf of 0.8 lagging with a terminal voltage of 11kV. Its armature resistance is 0.4Ω per phase while synchronous reactance is 3Ω per phase. Calculate the line value of emf induced and full load regulation. (5)

PART C

Answer any twofull questions, each carries 10 marks.

12 a) Explain the procedure to conduct slip test with a neat circuit diagram (5)

b) Explain synchronisation of alternators using dark lamp method. (5)

13 a) Explain any one method of starting of synchronous motor. (4)

b) A 2000V, 3-phase, 4 pole star connected synchronous motor runs at 1500 rpm. The excitation is constant and corresponds to an open circuit voltage of 2000V. The resistance is negligible compared to synchronous reactance of 3Ω per phase. Determine power input, power factor, torque developed for an armature current of 200A (6)

14 a) Explain the effect of change in excitation of an alternator? (5)

b) A 400V, 4-pole, 3-phase, 50Hz, star connected induction motor has rotor resistance and reactance per phase 0.01Ω and 0.1Ω respectively. Determine a) starting torque b) slip at maximum torque and c) maximum torque. Given rotor to stator turns is 0.25. (5)

PART D

Answer any twofull questions, each carries 10 marks.

15 Draw the circle diagram of a 20 Hp, 400 V, 50 Hz, 3-phase, star-connected induction motor from the following test data (line values) (10)

No load Test : 400V, 9 A , 0.2 pf

Blocked Rotor Test : 200V, 50 A, 0.4 pf

From the circle diagram, find the line current and power factor at full load.

The stator and rotor copper losses are divided equally in the blocked rotor test.

16 a) Explain with neat diagram, star-delta starter in 3-phase induction motor. (5)

b) Compare induction generator with synchronous generator. (5)

17 a) Explain types of single-phase induction motors with relevant figures? (8)

b) Draw the equivalent circuit of single-phase induction motor (2)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES

Max. Marks: 100 Duration: 3 Hours

Graphs sheets shall be supplied.

PART A

Answer all questions, each carries 5 marks. Marks

1 Explain the term pitch factor in an alternator and derive an expression for it. Also discuss the effect of short pitching on harmonics. (5)

2 Define armature reaction. Explain the effect of armature reaction on the terminal voltage of an alternator at zero leading power factor load. (5)

3 Explain why X_d and X_q are different for salient pole alternators whereas they are the same for the smooth rotor machines. (5)

4 Explain the working of a synchronous condenser. (5)

5 How would you rate the performance of an autotransformer starter with a DOL starter used in an induction motor? (5)

6 Equivalent circuit parameters of a 3 phase induction motor can be determined from no load and blocked rotor tests. Justify. (5)

7 Explain the principle of shaded pole induction motor with suitable diagram. (5)

8 Using equivalent circuit prove that the induction machine becomes a generator when the machine is driven above synchronous speed. (5)

PART B

Answer any two full questions, each carries 10 marks.

9 a) Differentiate between salient pole type and cylindrical type alternator with sketches. (5)

b) Derive the EMF equation of an alternator. (5)

10 The open-circuit test data for a 3-phase, 3.5 MVA, 4.16 kV, 50 Hz star connected synchronous generator are given below. (10)

Open-circuit characteristic:

I_f (A)	50	100	150	200	250	300	350	400	450
V_{OC} (line) (kV)	1.62	3.15	4.16	4.75	5.13	5.37	5.55	5.65	5.75

A field current of 200A is found necessary to circulate full load current on short circuit of the alternator. The machine supplies full-load at a p.f. of 0.8 lagging. Determine its voltage regulation by (i) EMF method (ii) MMF method. Neglect resistance.

11 a) Show that the output emf wave of an alternator do not contain even harmonics. (5)

b) Find the distribution factor and pitch factor of a 3 phase 4 pole 24 slots alternator having its armature coils short pitched by one slot. (5)

PART C

Answer any two full questions, each carries 10 marks.

12 a) Derive the expression for mechanical power developed in a cylindrical rotor type synchronous motor. (6)

b) A 2.3kV, 3 phase star connected synchronous motor has Z_s = (0.2 + j 2.2) ohms per phase. The motor is operating at 0.5pf leading with a line current of 200A. Determine the induced emf per phase. (4)

13 a) Derive an expression for developed torque in a 3-phase induction motor and find the condition for maximum torque. Also sketch the torque-slip curve. (6)

b) A 746KW, 3-phase, 50Hz, 16 pole induction motor has a rotor impedance of (0.02+j0.15) ohm at stand still. Full load torque is obtained at 360 rpm. Calculate (i) the ratio of maximum to full load torque and (ii) the speed corresponding to max torque. (4)

14 a) Explain the effect of change in excitation in parallel operation of alternators. (6)

b) The power input to a 500V, 50Hz, 6-pole, 3-phase induction motor running at 975 rpm is 40KW. The stator losses are 1KW and the friction and windage losses total 2KW. Calculate: (i) the slip (ii) the rotor copper loss (iii) shaft power and (iv) the efficiency. (4)

PART D

Answer any two full questions, each carries 10 marks.

15 Draw the circle diagram for a 3.73kW, 200V, 50Hz, 4 pole 3 phase star connected induction motor from the following data : (10)

No load Test : 200V, 5A, 350W

Blocked Rotor Test: 100V, 26A, 1700W

Rotor copper loss at stand still = half of the total copper loss

Construct the circle diagram and estimate: (i) full load current, (ii) power factor at full-load and (iii) maximum torque in terms of full-load torque.

16 a) Explain the phenomenon crawling as applied to induction motor. (5)

b) Explain how pulling into step is achieved in synchronous induction motor. (5)

17 a) Differentiate between plugging and regenerative braking as applied to induction motors. (4)

b) If the standstill impedance of the outer cage of a double cage induction motor is (2+j0.4) ohm and of the inner cage is (0.4+j2) ohm, compare the relative torques of two cages (i) at standstill (ii) at a slip of 5%. (6)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES (EE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

Graph sheets may be supplied

1		Derive the expressions for 'Distribution factor' and prove that distribution factor approaches a constant value as number of slots/pole increases.	(5)
2		Explain the EMF method of determining voltage regulation of an alternator.	(5)
3		Explain the effects of change in excitation when two alternators are connected in parallel.	(5)
4		A 2 pole, 3-phase Induction motor runs at 2910 rpm on a 50Hz supply. Find (i) synchronous speed and (ii) frequency of rotor emf.	(5)
5		Describe the constructional feature of double cage induction motor to obtain large starting torque.	(5)
6		Explain how the shunt parameters of the equivalent circuit of a 3-phase Induction motor can be obtained from no-load test.	(5)
7		Explain the principle of operation of an Induction generator.	(5)
8		Explain the working of shaded pole motor.	(5)

PART B

Answer any two full questions, each carries 10 marks.

9	a)	Derive the expression for pitch factor. Also find the value of short pitching angle to eliminate fifth harmonics completely.	(6)
	b)	Derive the emf equation of an alternator. (Expressions for pitch and distribution factors need not be derived)	(4)
10		A 3-phase, 4-pole, star connected alternator has a smooth cylindrical type rotor. The effective resistance and synchronous reactance per phase are 0.15Ω and 2.5Ω respectively. Calculate the voltage regulation when delivering 250 A at 6.6 kV at different power factors of (i) 0.6 pf lagging. (ii) upf (iii)0.8 pf leading.	(10)

11 a) A 3-phase, 4 pole, 50 Hz, synchronous generator has 48 slots in which double layer winding is housed. Each coil has 10 turns short pitched by an angle of 36^0 electrical. Flux/pole is 0.025 Wb (sinusoidally distributed). Then, for a 3phase, Y connection, find (i) the line to line induced emf (ii) the fifth harmonic component of line to line induced emf. (6)

b) List the effects of armature reaction in a synchronous generator at upf, zero pf lag and zero pf lead? (4)

PART C

Answer any two full questions, each carries 10 marks.

12 Describe the synchronising procedure using dark lamp and bright lamp methods. (10)

13 a) Explain clearly how a rotating magnetic field is setup around the stator of a 3-phase Induction motor when a 3-phase supply is fed to it. (6)

b) Define slip related to an Induction motor. What is the expression for slip? (4)

14 a) Draw the phasor diagram of a salient pole alternator supplying a current which leads line voltage V and lags the generated voltage E. (5)

b) Draw and explain the V-curve and Inverted V-curve of a synchronous motor (5)

PART D

Answer any two full questions, each carries 10 marks.

15 A 4 pole, 50Hz, 415V, 37kW, delta connected , 3-phase Induction motor gave the following test results: (10)
No load test: 415V, 16A, 1.75kW
Blocked rotor test: 100V, 55A, 1.85kW
Draw the circle diagram and find the input line current and input power factor at full load. Assume rotor Cu loss at standstill is equal to half of total Cu loss.

16 Describe the following single phase Induction motors: (i) Capacitor start type and (ii) split phase type with torque-speed characteristics and phasor diagram (10)

17 a) Find the line current drawn from the supply when a 3-phase Induction motor is started using (i) a star-delta starter, (ii) Auto transformer of ratio 0.5, if the line current drawn from the supply is 6A without any starter. (5)

b) Explain the double revolving field theory related to single phase Induction motor. (5)

****