MUZAFFARPUR INSTITUTE OF TECHNOLOGY, Muzaffarpur

COURSE FILE

OF

Machine II

(031403)

Faculty Name:

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Content

S.No.	Topic
1	Vision of department
2	Mission of department
3	PEO’s
4	PO’s
5	Course objectives and course outcomes (Co)
6	Mapping of CO’s with PO’s
7	Course syllabus and GATE syllabus
8	Time table
9	Student list
10	Lecture plans
11	Assignments
12	Tutorial sheets
13	Seasonal question paper
14	University question paper
15	Result
16	Result analysis

VISION STATEMENT OF ELECTRICAL ENGINEERING DEPARTMENT

To produce cutting edge Electrical Engineers, innovators, researchers, and entrepreneurs with high human values to serve society, industry, nation and the world.

MISSION STATEMENT OF ELECTRICAL ENGINEERING DEPARTMENT

M1. To create state-of-the-art facilities for under-graduate, post- graduate and R&D work.

M2. To cater the needs of society with recent technologies, innovative ideas and inculcate ethical responsibilities.

M3. To develop strong collaborative links with premier industries, institutions and the government agencies.

Program Educational Objectives (PEOs) of Electrical Engineering Department:

- **PEO 1.** Students will be able to engage in life-long learning and research including supportive and responsible roles on multi-disciplinary tasks.
- **PEO 2.** Students will acquire, use and develop skills as required for effective professional and societal practices and leadership quality.
- **PEO 3.** Students will be able to create a new dimension of innovation and entrepreneurship.

Program Outcomes (POs) based on Program Educational Objectives (PEOs) of Electrical Engineering Department:

- **PO 1.** Students will be able to apply knowledge of applied mathematics & science in electrical engineering problems.
- **PO 2.** Students will be able to identify, formulate and solve society and industries related problems.
- **PO 3.** Students will be able to apply knowledge to design a system, component or process to meet desired needs within realistic constraints.
- **PO 4.** Students will be able to conduct laboratory experiments and to critically analyze and interpret experimental data.
- **PO 5.** Students will be able to use the recent techniques, skills, and modern tools necessary for engineering practices.
- **PO 6.** Students will be able to understand the impact of engineering problems, solutions in a global and societal context.
- **PO 7.** Students will be able to demonstrate professional and ethical responsibilities.
- **PO 8.** Students will be able to apply leadership quality to work with team in the area of electrical engineering towards the solution of multi-disciplinary tasks.
- **PO 9.** Students will be able to communicate effectively through verbally, technical writing, reports and presentation.
- **PO 10.** Students will be able to develop confidence for self-education and ability to engage in life-long learning.

COURSE OBJECTIVE AND COURSE OUTCOMES:

Institute/college Name	Muzaffarpur Institute of Technology, Muzaffarpur
Program Name	B.E. Electrical (IV semester)
Course Code/course credits	031403 (4)
Course Name	Machine II
Lecture/ Sessional (per week)	3/1
SEE duration	4 hours
Course Coordinator Name	Mr. R. K. Mishra

Course objective:

This course is designed to achieve Excellency in the area of 3- phase alternator and 3- phase synchronous motor , single phase induction motor , and some special machine like as single phase synchronous motor, hysteresis motor , stepper motor etc. All above said machine is very use full in the area of industry and social, domestic life to fulfill the need of human and helpful the growth of society and country. The electrical machine –II covers the fractional kilowatt and special types of machine which has versatile used in daily life. This course enhances the knowledge and skills to faithful operation and development of machine.

Course outcomes (CO):

CO1	Students are able to understand the basic construction, mechanism of MMFs, Electromagnetic torque production 3-phase Syn. m/c, 1-Phase IMs & special m/c.
CO2	Students are expected to learn to identify types of machine & connection mechanisms and analyse operation & applications of 3-phase SMs and 1-phase IMs.
CO3	Students are expected to learn to analyse and evaluate 3-phase Synchronous machine performance for both cylindrical rotor & salient rotor SMs along with 1-phase IMs.
CO4	Students are expected to be able to predict 3-phase Syn. m/c, 1-phase IMs performance from name-plate data, and able to conduct tests to evaluate parameters of the above machinery.
CO5	Students are expected to be able to decipher and represent machine performance through such cryptic forms as phasor diagrams.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	1	1	-	-	-	-	-
CO2	2	3	1	1	1	1	1	-	-	-	-	-
CO3	1	3	1	2	1	1	1	-	-	-	1	-
CO4	2	2	1	3	1	1	1	-	-	-	1	-
CO5	2	2	1	2	1	1	1	-	-	-	1	-

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

It there is no correlation, put "-"

Course syllabus of Electrical machine-II

Synchronous Generator: Principle, construction and types of synchronous machines, Methods of excitation, Armature windings, EMF equation of Alternator, Armature reaction, testing (OC and SC test) Voltage regulation, Phasor diagram.

Two reaction : Theory Modified Phasor diagram, Power angle characteristics, Parallel operation. Effect of change of fuel supply and excitation on alternator connected to infinite bus , Cooling of synchronous Generator.

Synchronous Motor: Principle of operation, equivalent circuit, effect of varying field current. V-curves, Inverted V-curves, Phasor diagram, starting of synchronous motors, hunting application.

Single phase induction motors: Introduction, Working principle, double revolving field theory, Equivalent circuit, Starting method and Types of single phase Induction motors, Applications.

Special motors : Single phase synchronous motors, Two phase AC Servo Motor, single phase series (universal) motor, stepper motor, Permanent magnet DC motor, etc, Applications.

GATE syllabus Electrical Machine-II

Operating principle of single phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

Student list:

S.NO.	*Roll No*	*Name*
1	16EE01	NANDAN KUMAR
2	16EE02	ANJALI KUMARI
3	16EE03	KAUSTUBHA
4	16EE04	RISHABH KUMAR
5	16EE05	AMRITA KUMARI
6	16EE06	SUMIT KUMAR
7	16EE07	RITESH RAJ
8	16EE08	VIPUL MISHRA
9	16EE09	SAMEER KUMAR
10	16EE10	MD SAIFULLAH SADIQUE
11	16EE11	PREETI KUMARI
12	16EE12	KULDEEP THAKUR
13	16EE13	SHANTANU KUMAR SINGH
14	16EE14	SEEMA KUMARI
15	16EE15	PRIYAM KUMARI
16	16EE16	VANDANA BIHARI
17	16EE17	RAJNANDANI
18	16EE18	SANJAY KUMAR YADAV
19	16EE19	PRAVEEN DIVAKAR
20	16EE20	AMIT KUMAR PANDIT
21	16EE21	CHANDAN KUMAR THAKUR
22	16EE22	ALOK KUMAR
23	16EE23	DEVENDRA KUMAR
24	16EE24	ARVIND KUMAR
25	16EE25	AMITESH KUMAR
26	16EE26	VIVEK KUMAR
27	16EE27	VIKASH KUMAR RAY
28	16EE28	ROHIT KUMAR
29	16EE29	OM PRAKASH KUMAR

30	16EE30	RAVI KUMAR
31	16EE31	SANDEEP KUMAR
32	16EE32	DEO ALOK
33	16EE33	BAJRANGI KUMAR
34	16EE34	MANOJ KUMAR SONI
35	16EE35	SANJEEV KUMAR
36	16EE36	NEERAJ KUMAR
37	16EE37	SATYAM KUMAR
38	16EE38	PRASHANT GAURAV
39	16EE39	NITISH KUMAR RAJAK
40	16EE40	UJJAWAL KUMAR
41	16EE41	PRABHAT KUMAR
42	16EE42	MD HASIM JILANI
43	16EE43	SHIV CHARAN KUMAR
44	16EE44	ANISH BHARTI
45	16EE45	RAHUL KUMAR
46	16EE46	RAJEEV RANJAN PRASAD
47	16EE47	SHUBHAM KUMAR
48	16EE48	TAHIR QAMAR
49	16EE49	PRASHANT KUMAR
50	16EE50	NAMAN KUMAR
51	16EE51	KESHAV CHANDRA
52	16EE52	SWETA BHARTI
53	16EE53	PRATIK ANAND
54	16EE54	SHAGUFTA ANJUM
55	16EE55	GOLDEN KUMAR
56	16EE56	MURLI MANOHAR
57	16EE57	ARPIT ANAND
58	16EE58	AKSHAT RAJ
59	16EE59	ANJAN KUMAR
60	16EE60	SUMAN KUMAR BHARTIYA
62	16EE61	SAKET

63	16EE62	RISHABH KUMAR
64	16EE63	SUMAN KUMAR
65	16EE64	SUNITA KUMARI
66	16EE65	NISHANT RAJ
67	16EE66	VIPIN SINGH
68	16EE67	ANKIT RAJ
69	16EE68	GUNJAN KUMAR
70	16EE69	PRATAP CHANDRA CHOUDHARY
71	17(LE)EE01	VIVEK KUMAR
72	17(LE)EE02	RITIK KUMAR
73	17(LE)EE03	ANAND RANJAN
74	17(LE)EE04	ABHISHEK KUMAR
75	17(LE)EE05	POONAM KUMARI
76	17(LE)EE06	SAURABH KUMAR JHA
77	17(LE)EE07	PARMANAND KUMAR
78	17(LE)EE08	ROHAN RAJ
79	17(LE)EE09	ANAND KUMAR
80	17(LE)EE10	MANISH

Course Handout

1. **Scope and Objectives of the Course**

This course is designed to achieve Excellency in the area of 3- phase alternator and 3-phase synchronous motor , single phase induction motor , and some special machine like as single phase synchronous motor, hysteresis motor , stepper motor etc. All above said machine is very use full in the area of industry and social, domestic life to fulfill the need of human and helpful the growth of society and country. The electrical machine –II covers the fractional kilowatt and special types of machine which has versatile used in daily life. This course enhances the knowledge and skills to faithful operation and development of machine.

2. **Textbooks**

TB1: Electrical machines by Nagrath I.J. and Kothari D.P. TMH
TB2: Electrical machinery by Fitzgerald A.E. & Kingsley: TMH

3. **Reference Books**

RB1: Electrical Machines by P.S. Bimbra , Khanna Publication.
RB2: Electrical machines by Samarjit Ghosh, Pearson Education Pvt. Ltd.

RB3: Electrical machines by purkait & bandyopadhyay, Oxford University press

Other readings and relevant websites

S.No.	**Link of Journals, Magazines, websites and Research Papers**
1.	https://www.youtube.com/watch?v=b24jORRoxEc&list=PL112E9458CF31C773
2.	https://www.youtube.com/watch?v=AvvtvVUz85o
3.	https://onlinecourses.nptel.ac.in

4. Course Plan

Lecture Number	Date of Lecture	Topics	Web Links for video lectures	Text Book / Reference Book / Other reading material	Page numbers of Text Book(s)
1-9		**Synchronous generator**		**RB1, TB1, RB3**	**444 – 473**
		Synchronous generator :Principle, construction and types of synchronous machines, Methods of excitation, Armature windings, EMF equation of Alternator, Armature reaction, Testing(OC and SC test) Voltage regulation, Phasor diagram.	https://www.youtube.com/watch?v=eRzVFeCacSM https://www.youtube.com/watch?v=tQsakkEnelc https://www.youtube.com/watch?v=jNyfPJTduC8		
10-18		**Two reaction**		**RB1, TB1, RB3**	**475-545**
		Theory Modified Phasor diagram, Power angle characteristics, Parallel operation, Effect of change of fuel supply and excitation on alternator connected to infinite bus, Cooling of synchronous Generator	https://www.youtube.com/watch?v=iueIURD4XWo https://www.youtube.com/watch?v=HSTVsg5wx_4 https://www.youtube.com/watch?v=fR8NzZEGZSw		
19-26		**Synchronous Motor**		**RB1, TB1, RB3**	**545-554**

		Principle of operation, equivalent circuit, effect of varying field current. V-curves, Inverted V-curves, Phasor diagram, starting of synchronous motors, hunting,	https://www.youtube.com/watch?v=80uxMISyzxI https://www.youtube.com/watch?v=WKjLOgfRnKY https://www.youtube.com/watch?v=SHk49rSvVp8		
27-34		**Single phase induction motors:**		**, TB1, RB3**	**702-722**
		Introduction, Working principle, Double revolving field theory, Equivalent circuit, Starting method and Types of single phase Induction motors, Applications.	https://www.youtube.com/watch?v=yL5egmaRxUM https://www.youtube.com/watch?v=PGs4BsWakZE		
35-42		**Special motors:**		**TB1, RB3**	**722-746**
		Single phase synchronous motors, Two phase AC Servo Motor, single phase series (universal) motor, stepper motor, Permanent magnet DC motor, Application	https://www.youtube.com/watch?v=pbg_PF6MTwY https://www.youtube.com/watch?v=eK12cYyMVOg https://www.youtube.com/watch?v=TWMai3oirnM https://www.youtube.com/watch?v=P8kjv1HwTVI		

	Lacture plan	
SL.No.	**Topic Name**	**Period**
1	**Synchronous Generator**	
	Principle, construction and types of synchronous machines	1
	Methods of excitation, Armature windings,	2
	EMF equation of Alternator, Armature reaction	2
	Testing(OC and SC test) Voltage regulation	2
	Phasor diagram.	2
2	**Two reaction**	
	Theory Modified Phasor diagram, Power angle characteristics,	3
	Parallel operation	2
	Effect of change of fuel supply and excitation on alternator connected to infinite bus	2
	Cooling of synchronous Generator	2
3	**Synchronous Motor**	
	Principle of operation	2
	equivalent circuit, effect of varying field current.	2
	V-curves, Inverted V-curves	2
	Phasor diagram, starting of synchronous motors	2
	hunting, application	1
4	**Single phase induction motors**	
	Introduction, Working principle	1
	Double revolving field theory	1
	Equivalent circuit,	2

	Starting method and Types of single phase Induction motors,	3
	Applications	1
5	**Special motors**	
	Single phase synchronous motors,	1
	Two phase AC Servo Motor	2
	single phase series (universal) motor	2
	stepper motor	2
	Permanent magnet DC motor, Application	1
	Total	42

Assignments:

Assignment I

1. Explain the excitation system of 3- phase synchronous generator.

2. Explain the equivalent circuit of 3-phase alternator & EMF method to compute the voltage regulation.

3. Under what conditions does the voltage regulation of a synchronous generator become negative?

4. Explain OCC & SCC in 3-phase synchronous generator.

5. Explain briefly the process of synchronizing a synchronous Generator to the bus-bars. What conditions determine the instant of synchronization?

Assignment II

1. Explain the operation & principle of 3-phase Synchronous Motor also described the method of starting of 3-phase Synchronous Motor.
2. Draw and explain V-curve and inverted V-curve of 3-phase Synchronous Motor.

3. Explain Hunting in Synchronous machine. Why salient rotor synchronous machine has more hunting than cylindrical rotor synchronous machine?
4. Explain power angle characteristics of 3-phase cylindrical rotor synchronous machine.
5. Explain why the SCC is linear?
6. Define the Damper winding in 3 phase Synchronous machine. Explain how Damper winding reduces the effect of hunting.

Assignment III

1. Explain why a single phase single winding induction motor not produces self starting torque.

2. What are servomotors and list their characteristics

3. Explain Capacitor- start single phase Induction motor.

4. Explain why hysteresis motor has highest electromagnetic torque at starting.

5. Explain why 1-phase universal motor works on both AC & DC.

6. Define Stepper motor & write its applications.

TUTORIAL -I

1. Find the no- load line voltage of a star – connected 4- pole, 50 Hz alternator from the following data:
   Flux per pole= 0.12 Wb, No. of slots/ pole / phase =4
   Conductor / slots= 4, Two layer winding with coil span 150 degree electrical.

2. A 3-phase, 600 kVA alternator has rated terminal voltage of 3300 V. the stator winding is star connected and has a resistance of 0.37 Ω/ phase and a synchronous reactance of 4.3 Ω/ phase. Calculate the voltage regulation for full –load at a p.f. of (i) unity (ii) 0.8 lagging.

3. A 3-phase, star-connected synchronous generator is rated at 1200 kVA, l l kV on short-circuit a field current of 55 A gives full-load current. The OC voltage with the same excitation is 1580 V/phase. Calculate the voltage regulation at (a) 0.8 lagging and (b) 0.8 leading pf.
   Neglect armature resistance.

4. The open- and short-circuit tests data on a 3-phase, 1 MVA, 3.6 kV, star-con nected synchronous generator is given below:

I_f (A)	60	70	80	90	100	110
V_{OC}(line) (V)	2560	3000	3360	3600	3800	3960
I_{SC} (A)	180					

   Find: (a) The unsaturated synchronous reactance.
(b) The adjusted synchronous reactance.
(c) The short-circuit ratio.
(d) The excitation voltage needed to give rated voltage at full-load, 0.8 lagging pf.

TUTORIAL -II

1. A 3300 V, star-connected synchronous motor is operating at constant terminal voltage and constant excitation. Its synchronous impedance is 0.8 + j5 W. It operates at a power factor of 0.8 leading when drawing 800 kW from the mains. Find its power factor when the input is increased to1200 kW, excitation remaining constant.

2. A 3300 V, star connected synchronous motor has synchronous impedance of 0.4+j0.5 Ω per phase. For an excitation e.m.f of 4000 V and motor input power of 1000 kW at rated voltage, compute the line current and pf.

3. A 600 V, 6-pole, 3-phase, 50 Hz, star-connected synchronous motor has a resistance and synchronous reactance of 0.4 W and 7 W respectively. It takes a current of 15 A at upf when operating with a certain field current. With the field current remaining constant, the load torque is increased until the motor draws a current of 50 A. Find the torque (gross) developed and the new power factor.

4. A 500 V, 3-phase, mesh-connected motor has an excitation emf of 600 V. The motor synchronous impedance is (0.4 + j5) W while the windage, friction and iron losses are 1200 W. What maximum power output can it deliver? What is the corresponding line current, pf and motor efficiency?

TUTORIAL –III

1. Calculate the synchronizing coefficient (in kW and Nm per mechanical degree) at fullload for a 1000 kVA, 0.8 pf (lag), 6.6 kV, 8-pole, star-connected cylindrical rotor generator of negligible resistance and synchronous reactance of 0.8 pu.

2. A salient-pole synchronous motor has Xd = 0.85 pu and Xq = 0.55 pu. It is connected to bus-bars of 1.0 pu voltage, while its excitation is adjusted to 1.2 pu. Calculate the maximum power output, the motor can supply without loss of synchronism. Compute the minimum pu excitation that is necessary for the machine to stay in synchronism while supplying the full-load torque (i.e. 1.0 pu power).

3. A 440 V, 50 Hz, Y-connected salient-pole synchronous generator has a direct-axis reactance of 0.12 W and a quadrature-axis reactance of 0.075 W per phase, the armature resistance being negligible. The generator is supplying 1000 A at 0.8 lagging pf.
   (a) Find the excitation emf, neglecting saliency and assuming Xs = Xd.
   (b) Find the excitation emf accounting for saliency.

4. Figure 1.1 shows two generators supplying in parallel a load of 2.8 MW at 0.8 pf lagging: (a) At what frequency is the system operating and what is the load supplied by each Generator?

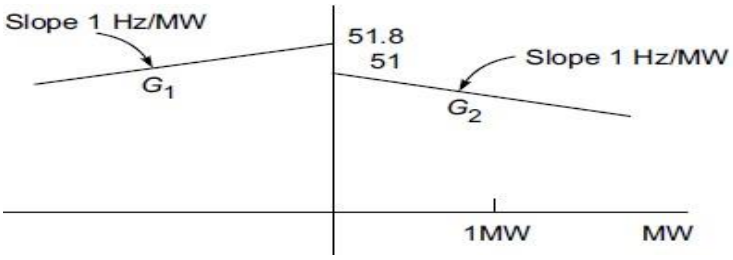

Fig.1.1

(b) If the load is now increased by 1 MW, what will be the new frequency and the load sharing?

(c) In part (b) which should be the set point of G2 for the system frequency to be 50 Hz? What would be the load sharing now?

TUTORIAL -IV

1. A 200 W, 230 V , 50 Hz , single – phase capacitor start motor has the following constants

   Main windings : R= 4.5Ω, X_L =3.7 Ω
   Starting winding: R= 9.5Ω, X_L =3.5 Ω
   Find the value of starting capacitance that will results in the maximum starting torque.

2. A 240 V, 50 Hz, single – phase capacitor start a.c. motor is loaded such that the slip is 6 %. The motor constants referred to the stator are:

   Stator resistance =2.2 Ω; rotor resistance= 3.8 Ω

   Stator reactance =3.0 Ω; rotor reactance = 2.1 Ω

   Magnetizing reactance =86 Ω; Iron and friction loss= 50 W

   Draw the equivalent circuit and form it, find the output power and efficiency at the given loading.

3. For a 2-phase servomotor with a high resistance rotor, find approximate expressions for forward and backward torques in terms of phase voltages

(differing 90° in phase) and motor speed. Assume the stator impedance and rotor reactance to be negligible

4. A universal motor (ac-operated) has a 2-pole armature with 960 conductors. At a certain load the motor speed is 5000 rpm and the armature current is 4.6 A; the armature terminal voltage and input are respectively 100 V and 300 W. Compute the following, assuming an armature resistance of 3.5 W.

(a) Effective armature reactance (b) Maximum value of useful flux/pole.

QUESTION BANK

with the armature short-circuitaed and full load current flowing, the field current is 18 A. when the m/c is applying full-load current at zero Bt at rated voltage, the field current is 45A.

Determine the leakage reactance in Ω per phase and the full-load armature reaction in terms of equivalent field amperes. Find also the field current and voltage regulation when the m/c is supplying full load at 0.8 p.f lagging at rated voltage neglect armature resistance.

4. For a salient-pole synchronous m/c, neglecting the effect of armature resistance, derive an expression for power developed as a function of load angle. 14

5. Two identical, $3-\phi$, star-connected generators. operating in prallel, share equally a total load of 750 kW at 6000 V and p.f 0.8. The synchronous reactance and resistance of each machine are respectively 50Ω and 2.5 Ω per phase. The field of first generator is excited so that armature current is 40 A (lagging). Find (O) the armature current of the second alternator; (b) the p.f of each machine (c) the electromotive force of each machine (d) the load angle of each machine.

 14

6. (a) What are V-curves of a synchronous motor? What are the main characteristic of a synchronous motor. 4

(b) A $3-\phi$, 11 kV star connected synch. motor takes 50 A input current. The effective resistance and synchronous reactance per phase are 1 Ω and 30 Ω respectivelly. Calculate the induced emf for a power factor of (a) 0.8 lagging (b) 0.8 leading and (c) the power supplied to the motor. 10

7. A 230V, 50 Hz, 4-pole single-phase Induction motor has the following equivalent circuit parameters: 14

$R_{1m} = R_2 = 8\Omega$

$X_{1m} = x_2 = 12\Omega,\ X_M = 200\Omega,$

at a slip of 4% calculate (a) input current (b) input power (c) developed power, and developed torque at rated voltage. The motor speed is 140 rpm.

8. (a) Draw and explain the phasor diagram of an ac series motor. 4

(b) A universal series motor, when operating on 220 V d.c draws 10A and runs at 1400 rpm. Find the new speed and p.f. when connected to 220 V, 25Hz supply, the motor current remains the same. The motor has total resistance of 1Ω and total inductance of D.1.H. 10

9. Describe the construction of permanent-magnet d.c. motor. What are the advantage and disadvantage of permanent magnet d.c. motor compared with conventional shunt d.c. motors? 14

Short Answer Questions :

1. Why almost all large size Synchronous machines are constructed with rotating field system type?
2. Write down the equation for frequency of emf induced in an Alternator.
3. Why do cylindrical Alternators operate with steam turbines?
4. Which type of Synchronous generators are used in Hydro-electric plants and why?
5. What are the advantages of salient pole type construction used for Synchronous machines?
6. Why is the stator core of Alternator laminated?
7. How does electrical degree differ from mechanical degree?
8. What is the relation between electrical degree and mechanical degree?
9. What is distributed winding?
10. Why is short pitch winding preferred over full-pitch winding ?
11. Write down the formula for distribution factor.
12. Define winding factor.
13. Why are Alternators rated in kVA and not in kW?
14. What are the causes of changes in voltage in Alternators when loaded?
15. What is meant by armature reaction in Alternators?
16. What do you mean by synchronous reactance?
17. What is meant by synchronous impedance of an Alternator?
18. What is meant by load angle of an Alternator?
19. Upon what factors does the load angle depend? An Alternator is found to have its terminal voltage on load condition more than that on no load. What is the nature of the load connected?
20. Define the term voltage regulation of Alternator.
21. What is the necessity for predetermination of voltage regulation?
22. Name the various methods for predetermining the voltage regulation of 3-phase Alternator.
23. How synchronous impedance is calculated from OCC and SCC?
24. What are the advantages and disadvantages of estimating the voltage regulation of an Alternator by EMF method?
25. Why is the synchronous impedance method of estimating voltage regulation considered as pessimistic method?
26. What are the tests data required for predetermining the voltage regulation of an Alternator by MMF method?
27. Why is the MMF method of estimating the voltage regulation considered as the optimistic method?
28. State the condition to be satisfied before connecting two alternators in parallel
29. How do the synchronizing lamps indicate the correctness of phase sequence between existing and incoming Alternators?
30. What are the advantages and disadvantages of three dark lamps method of synchronizing?
31. How Synchronoscope is used for synchronizing Alternators?

32. Why synchronous generators are to be constructed with more synchronous reactance and negligible resistance?
33. List the factors that affect the load sharing in parallel operating generators?
34. How does the change in prime mover input affect the load sharing?
35. How does change in excitation affects the load sharing?
36. What steps are to be taken before disconnecting one Alternator from parallel operation?
37. What is meant by infinite bus-bars?
38. How does increase in excitation of the Alternator connected to infinite bus-bars affect this operation?
39. In what respect does a 1-phase Induction motor differ from a 3-phase Induction motor?
40. What are the inherent characteristics of plain 1-phase Induction motor?
41. Name the two different theories with which principle of 1-phase induction motors are explained.
42. State double revolving field theory.
43. Name any four types of 1-phase induction motors.
44. Why are centrifugal switches provided on many 1-phase Induction motors?
45. How the direction of a capacitor start Induction motor is be reversed?
46. Can the starting torque of a slip ring induction motor being increased?
47. What happens if the air gap flux density in an induction motor increases?
48. State the advantages of skewing?
49. What are the effects of increasing rotor resistance on starting current and starting torque?
50. What is slip of an induction motor?
51. How the magnitude of rotor emf is related to the slip in an I M?
52. How the frequency of rotor emf is related to the slip in an I M?
53. What is the normal value of slip of an I M operating at full load?
54. Why is not possible for the rotor speed of an I M to be equal to the speed of its rotating magnetic field?
55. State the condition at which the torque developed in a 3 phase induction motor is maximum.
56. What are the advantages of slip-ring I M over cage I M?
57. What are the losses occurring in an I M and on what factors do they depend?
58. What care should be taken at the time of construction to reduce eddy current losses in I M?
59. Why are there not appreciable magnetic losses in the rotor core of Induction motors?
60. What is meant by synchronous watt?
61. State the characteristic features of synchronous motor.
62. In what way synchronous motor is different from other motors?
63. Name any two methods of starting a synchronous motors
64. What is the effect on speed if the load is increased on a 3 phase synchronous motor?
65. Why a synchronous motor is a constant speed motor?
66. What is the phasor relation between induced emf and terminal voltage of a 3 phase synchronous motor?
67. At what load angle is power developed in a synchronous motor becomes its maximum value?

68. What are V and inverted V curves of synchronous motor?
69. What happens when the field current of a synchronous motor is increased beyond the normal value at constant input?
70. Distinguish between synchronous phase modifier and synchronous condenser 71. How the synchronous motor can be used as s synchronous condenser?
72. What type of single phase induction motor would you use for the following applications?
73. After servicing a single phase fan it was found to run in reverse direction. What could be the reason?
74. What will be the direction of rotation of a shaded pole single phase induction motor?
75. What is the property of a single phase single winding induction motor?
76. Which winding in a double cage induction motor has high resistance and low Inductance

Long answer Questions

1. State the requirements for paralleling of alternators.

2. A two pole,50 Hz, 3-phase, turbo alternator is excited to generate the bus-bar voltage of 11 kV on no load.The machine is star connected and the short circuit current for this excitation is 1000A. Calculate the synchronizing power per degree of mechanical displacement of the rotor and the corresponding synchronizing torque.

3. 3. A 3300V, 3 phase star connected alternator has a full load current of 100A on short circuit a field current of 5A was necessary to produce full-load current. The e m f on open circuit for the same excitation was 900V.The armature resistance was 0.8 ohm/phase. Determine the full load voltage regulation for (i) 0.8 p f lagging (ii) 0.8 p f leading.

4. Explain the construction and principle of operation of 3-phase alternator

5. A 3-phase ,star connected, 16 pole alternaror has 192 slots with 8 conductors per slot, coil span=160 electrical degrees, speed of alternator=375 rpm, flux per pole=55mWb.Calculate the line and phase values of EMF generated.

6. Describe any two methods of determining the voltage regulation of 3-phase Alternator.

7. Explain the operation of single phase induction motor on the basis of double field revolving theory.

8. Explain the operation of the types of stepper motors.
9. A 3 MVA, 50Hz, 11 kV, 3-phase star connected alternator supplies 100A at zero p f leading. The line voltage is 12370V.When the load is removed, the line voltage is 1100V.Find the regulation at full load,0.8 pf lagging. Ra=0,4ohm/phase.

10. Bring out the characteristics of two alternators working in parallel. What is the effect of change in excitation on load sharing?

11. Derive the equation for torque developed by an 1-phase I M. Draw the typical torque slip curve and deduce the condition for maximum torque.

12. Write a note on Hysteresis motor.

13. Write short notes on (i)A C series motor (ii) Reluctance motor

14. How do you determine the direct axis and quadrature axis reactances of a salient pole alternator?

15. 19. A three phase star connected alternator has direct axis synchronous reactance of 0,7p u and quadrature axis reactance of 0,5 p u,If the generator delivers kVA at rated voltage at full load and lagging, find the percentage regulation. Resistance drop at full load is 0.017 p u.
16. Two alternators are connected in parallel, what happens when we (i) increase the excitation of one machine (ii) increase the steam supply of one machine.
17. Two similar 3000kVA synchronous generators work in parallel. The governor of first machine is such that frequency drops uniformly from 50Hz on no load to 48 Hz on full load. The corresponding speed drop of second machine is from 50Hz to 47.5Hz.determine the following (i) How will the two machines share a load 5000kW at full load (ii) What is the maximum load at u p f that can be delivered without overloading either of the two machines.

18. Explain why synchronous motor is not self starting.

19. Derive the EMF Equation of 3 phase alternator .Define distribution factor and coil span factor?

20. Explain V-curve and inverted V-curve in 3-phase synchronous motor.

21. Explain the power angle characteristics in cylindrical synchronous machine.
22. Explain the Equivalent circuit of 3-phase alternator.
23. Briefly explain the hunting in 3-phase synchronous motor.

24. Explain the power angle characteristics in salient pole syn. Machine.

25. A 200 kVA, 480-V, 60-Hz, 4-pole, Y-Connected synchronous generator with a rated field current of 5 A was tested and the following data was taken.
    a) from OC test – terminal voltage = 540 V at rated field current
    b) from SC test – line current = 300A at rated field current
    c) From Dc test – DC voltage of 10 V applied to two terminals, a current of 25 A was measured. Calculate the (i) speed of rotation in r/min (ii) the generated emf and saturated equivalent circuit parameters (armature resistance and synchronous reactance)