EEE 2013 III Year I

Code No: 09A50206 R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech III Year I Semester Examinations, May/June – 2013
Electrical Machines – III
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Define the terms pitch factor and distribution factor in case of an alternator. Derive an expression for distribution factor.

b) A 3 phase, 50 Hz, 16 pole synchronous generator has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 Webers, sinusoidally distributed and the speed is 375 rpm. Calculate the line induced emf. Take pitch factor as 1. [15]

2.a) Describe the principle and construction of slow speed operated generator with neat diagram.

b) Derive the EMF equation of a 3-phase alternator. [15]

3. The open circuit and short circuit test readings for a 3-phase star connected, 1000kVA, 2000V, 50 Hz synchronous generator are

V_{occ}(V)	800	1500	1760	2000	2350	2600
I_{SC}(A)	-	200	250	300	-	-
I_f(A)	10	20	25	30	40	50

The armature effective resistance is 0.2 Ω/ phase. Draw the characteristic curves and find full load percentage regulation at (a) 0.8 PF lagging, (b) 0.8 PF leading and (c) UPF. Use MMF method. [15]

4.a) Explain the condition for parallel operation of 3-phase alternator with neat diagram.

b) A 3-phase, 50 Hz, 2 pole alternator is excited to generate the bus bar voltages of 11 kV at no load. Calculate the synchronizing power per degree of mechanical displacement of the rotor. The machine is star connected and the short circuit current for this excitation is 1200 amperes. Neglect armature winding resistance. [15]

5.a) Explain V and Inverted V curves of a 3-phase synchronous motor.

b) Explain various torques associated with synchronous motor. [15]

6.a) Explain different methods of starting a 3-phase synchronous motor.

b) A 3300V, 3 phase synchronous motor running at 1500 rpm has its excitation kept constant corresponding to no-load terminal voltage of 3000V. Determine the power input, power factor and torque developed for an armature current of 250A if the synchronous reactance is 5Ω per phase and armature resistance is neglected. [15]

7.a) What is the function of capacitor in a single phase induction motor?

b) Develop equivalent circuit of a single phase induction motor ignoring core losses. [15]

8.a) Describe the constructional features of a 3-phase ac series commutator motor. How is the speed control affected in such a motor?

b) State the applications of stepper motor. [15]

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech III Year I Semester Examinations, June/July-2014
ELECTRICAL MACHINES-III
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1.(a) Derive an expression for an induced e.m.f in a synchronous generator from fundamentals.

(b) A 50Hz alternator has a flux of 0.1 wb/pole, sinusoidally distributed. Calculate the r.m.s. value of the generated e.m.f in one turn of the winding which spans ¾ of a pole pitch.

2.(a) Explain the effects of harmonics present in generated emf of alternator

(b) The phase EMF of a 3-Phase alternator consists of fundamental, 15 % 3rd harmonic and 5 % fifth harmonic. The amplitude of fundamental is 2000 V. Calculate, the RMS value of line & phase voltage, when the alternator is connected in (i) Star (ii) Delta.

3. A 1 MVA, 11 kV, 3-ϕ, star connected synchronous machine has following OCC test data:

I_f(A)	50	110	140	180
E_{OL}(KV)	7	12.5	13.75	180

(Where E_{OL} is the line voltage at no load)

The short circuit test yielded full load current at a field current of 60A. The ZPF yielded a full load current at terminal voltage for a field current of 150 A. The armature resistance is negligible. Calculate the voltage regulation at full load 0.866 pf lagging by Potier triangle method.

4.(a) Explain the various methods of synchronization of alternators.

(b) Two similar 4 MVA alternators operate in parallel. The governor of first machine is such that frequency drops from 50 Hz at no load to 47.5 Hz at full load. The corresponding drop for second machine is 50 Hz to 48 Hz.

i) How will they share a load of 6 MW?

ii) What is the maximum load they can share at UPF without over loading any generator?

5. A 3-ϕ, 400 V, 40 KVA, star connected synchronous motor is supplying 15 kW load with 0.8 pf lagging. The windage and friction losses are 1.5 kW and core losses are 1.0 kW. Calculate the following:

(a) Armature current and Excitation voltage

(b) Armature current and power factor if the excitation is increased by 40% and power supplied to the load remains constant.

6.(a) Explain the construction of 'power circle' for a synchronous motor.
(b) Explain briefly different methods of starting synchronous motors.

7.(a) Explain the equivalent circuit of single phase induction motor based on double filed revolving theory.
(b) Write short notes on split phase motors and capacitor start motor.

8.(a) Explain the construction of variable reluctance stepper motor.
(b) Explain the torque-speed characteristics of AC series motor.

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Code No: 09A50206 | R09 | SET-1

B. Tech III Year I Semester Examinations, December-2011
ELECTRICAL MACHINES – III
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Discuss the constructional details of synchronous machine.
b) Mention the differences between salient pole and non salient pole synchronous machine. [7+8]

2. Derive the emf equation of alternator, explain the coil span factor, distribution factor and derive the expressions? [15]

3.a) What are the causes of harmonics in the voltage waveform of an alternator?
b) Enumerate various methods used for minimizing harmonics in turbo-alternator.
c) Explain the effect of "armature reaction" in alternators for lagging power factor load, with mmf diagram. [15]

4. A 3-phase, star-connected alternator is rated at 1600 kva, 13500v. The armature effective resistance and synchronous reactance are 1.5Ω and 30Ω respectively per phase. Calculate the percentage regulation for a load of 1280kw at power factors of 0.8 leading 0.8 lagging. [15]

5. Two three-phase alternators operate in parallel. The rating of one machine is 50MW and that of the other is 100MW. Both alternators are fitted with governors having a droop of 4%. How will the machines share a common load of 100MW? [15]

6. Explain V – curves and $\wedge$ - curves of 3-phase synchronous motor. [15]

7. Explain the double field revolving theory of single phase induction motor. [15]

8. Explain the operation of universal motor. [15]

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Code No: 09A50206 | R09 | SET-2

B. Tech III Year I Semester Examinations, December-2011
ELECTRICAL MACHINES – III
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. Describe with neat sketch, the constructional details of salient pole alternators. [15]
2. A 3-phase, 8-pole, 750 rpm star – connected alternator has 72 slots on the armature. Each slot has 12 conductors and winding is short chorded by 2 slots. Find the induced emf between lines, given the flux per pole is 0.06 wb. [15]
3. What is armature reaction? Explain the effect of armature reaction on the terminal voltage of an alternator at
   i) Unity power factor load
   ii) Zero loading P.F load
   iii) Zero lagging P-F load and draw the corresponding phasor diagrams. [15]
4. A straight – line law connects terminal voltage and load of a 3-phase star – connected alternator delivering current at 0.8 P.f lagging. At no load, the terminal voltage is 3500V and at full load of 2280kw, it is 3300v. Calculate the terminal voltage when delivering current to a 3-phase, star- connected load having a resistance of 8Ω and a reactance of 6Ω per phase. Assume constant speed and field excitation. [15]
5. A synchronous generator operates on constant - voltage constant frequency bus bars. Explain the effect of variation of a) excitation b) steam supply on power output ,power factor, armature current and load angle of the machine. [15]
6. Explain the effect of varying excitation on armature current and power factor in a synchronous motor. Draw V – curves and state their significance. [15]
7. A 3000V, 3-phase synchronous motor running at 1500 y.p.m has its excitation kept constant corresponding to no – load terminal voltage of 3000V. Determine the power input, power factor and torque developed for an armature current of 250A if the synchronous reactance is 5Ω per phase and armature resistance is neglected. [15]
8. Discuss the principle of operation of single phase capacitor start and capacitor run motors. [15]

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Code No: 09A50206 | R09 | SET-3

B. Tech III Year I Semester Examinations, December-2011
ELECTRICAL MACHINES – III
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. What are the different types of ac generators in use? Explain their constructional features and essential differences in their construction. [15]

2.a) Calculate the distribution factor for a 36-slot, 4-pole single layer 3-phase winding.
b) Derive the emf equation of synchronous generator from the fundamental principles. [7+8]

3.a) Explain the effect of load power factor on the armature reaction of alternator.
b) Explain briefly load characteristics of alternator. [8+7]

4. A 3-phase, 1500 kvA, star-connected, 50-Hz, 2300v alternator has a resistance of 0.12Ω. A field current of 70A produces a short – circuit current equal to fuel load current of 376A in each line. The same field current produces an emf of 700V on open circuit. Determine the synchronous reactance of the machine and its full load regulation at 0.8 lagging power factor. [15]

5. What do you mean by synchronization of alternator? Describe any one method of synchronizing? [15]

6. A 3-phase, 11000v, star – connected synchronous motor takes a load current of 100A. The effective reactance and resistance per phase are 30Ω and 0.8Ω respectively. Find power supplied to the motor and induced e.m.f for
a) 0.8 power factor lagging b) 0.8 p.f leading. [15]

7.a) Explain why synchronous motor is not a self starting motor.
b) Briefly explain different starting methods of synchronous motor. [7+8]

8.a) Discuss the double revolving field theory of single phase induction motor.
b) Explain principle of operation of single phase induction motor. [7+8]

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Code No: 09A50206	R09	SET-4

B. Tech III Year I Semester Examinations, December-2011
ELECTRICAL MACHINES – III
(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Explain the constructional details of synchronous machine.
b) Where salient pole rotors are preferred. [7+8]

2.a) What are the advantages and disadvantages of using short – pitched winding and distributed winding in alternator?
b) Derive the expression of coil span factor and distribution factor. [7+8]

3. With relevant diagrams, explain the effect of load power factor on the armature reaction of alternator. [15]

4. A 3 – phase, star – connected, 1000 KVA, 2000v, 50Hz alternator gave the following open circuit and short – circuit test readings:

Field current :	A	10	20	25	30	40	45
O.C voltage :	V	800	1500	1760	2000	2350	2600
S.C armature current:	A		200	250	300		

Armature resistance per phase is 0.2Ω
Draw the characteristics and determine the full load percentage regulation at
a) 0.8 P.F. lead b) 0.8 p.f lag. [15]

5. Draw and explain the phasor diagram of salient pole alternator supplying full load lagging power current. Show that the power output per phase is given by

$$P = \frac{E_v}{X_d}\sin\delta + \frac{V^2}{2}\left[\frac{1}{x_9} - \frac{1}{x_d}\right]\sin 2\delta\,.$$ [15]

6. Two station generators A and B operate in parallel station capacity of A is 50Mw and that of B is 25 Mw. Full load speed regulation of station A is 3% and full load speed regulation of B is 3.5%. Calculate the load sharing if the connected load is 50MW, No – load frequency is 50Hz. [15]

7. Describe briefly the effect of varying excitation upon armature current and power factor of a synchronous motor when input power to the motor is maintained constant. [15]

8. Explain the principle and constructional features of stepper motor. [15]

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Code No: 09A50206 R09

JAWAHRALAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, November/December-2012
ELECTRICAL MACHINES – III
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. A 50 Hz, 600 rpm salient pole synchronous generator has a sinusoidal flux density having a maximum value of 1 tesla. The generator has 180 slots wound with 2- layer, 3-turn coils. The coil span is 15 slots and phase spread is 60^0. The armature diameter is 1.25 m and core length 0.45 m. Find (i) peak value of emf/conductor (ii) peak value of emf/coil (iii) rms phase and line voltage, if the machine is star connected. [15]

2.a) What are slot harmonics? How can they be reduced?
b) Find the rms value of different harmonic components for a 50 Hz, 3-ϕ synchronous generator having the following parameters: Number of poles = 10, slots/pole/phase = 2, conductors/slot(two layers) = 4, coil span = 150^0, Fundamental flux/pole = 0.12 Wb. The analysis of gap flux density shows a 20% third harmonic. All coils of a phase are in series. [15]

3. Discuss the synchronous impedance and mmf methods of calculating regulation of an alternator. Why do these methods give different results? [15]

4. Bring out the characteristics of the alternators working in parallel. What is the effect of change in excitation and change in mechanical power input on load sharing? [15]

5.a) What is a synchronous condenser? Give its applications.
b) Derive the power angle characteristics of synchronous motor. [15]

6.a) Explain the operation of synchronous induction motor.
b) Explain the methods of starting of synchronous motor. [15]

7.a) Draw the equivalent circuit of single phase induction motor. How can the performance of the motor be analyzed?
b) A 220 V, 1-ϕ induction motor gave the following test results:
Blocked rotor test: 110 V, 10 A, 400 W.
No-load test: 220 V, 4 A, 100W.
Find the parameters of equivalent circuit. Neglect R_0. [15]

8.a) Draw a diagram showing the construction of a stepper motor and discuss its operation.
b) What is a Universal motor? Draw its phasor diagram and discuss its operation. [15]

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