Code No: **R31025** **R10** **Set No. 1**

III B.Tech I Semester Supplementary Examinations, June/July - 2015

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) Explain the operation of a single phase induction motor using split phase technique. [8]

b) Show that the starting torque of a single phase induction motor is zero. [7]

2 a) Distinguish between distributed and concentrated windings. Also explain any one type of distributed winding employed in synchronous machines. [8]

b) An 8-pole alternator has an armature with 30 slots and 8 conductors per slot. The flux per pole is 0.08 Wb and machine rotates at 750 rpm. Calculate EMF generated, if winding factor is 0.94 and all conductors in a phase are connected in series. [7]

3 a) Explain the effect of armature reaction on the performance of an alternator. How it depends on the load power factor? Explain with suitable diagrams. [8]

b) Determine the values of pitch factor and distribution factor for a three phase winding with 4 slots/pole/phase and a coil span of 10 teeth. Calculate the percentage increase in the r.m.s value of phase voltage due to a 25% 3rd harmonic. [7]

4 a) The following test results are obtained from a 3 phase, 6000 kVA, 6600V, star connected, 2 pole, 50 Hz turbo alternator: With a field current of 125A, the open circuit voltage is 8000V at the rated speed; with the same field current and rated speed the short circuit current is 800A. At the rated full load, the resistance drop is 3%. Find the regulation of alternator on full load and at a p.f. of 0.8 lagging. [9]

b) What are the merits and limitations of ZPF method? [6]

5 a) Explain the procedure to bring the incoming machine to operate in parallel with running machines. [8]

b) A 3 MVA, 6-pole alternator runs at 1000 r.p.m in parallel with other machines on 3.3 kV bus-bars. The synchronous reactance is 20%. Calculate the synchronizing power per one mechanical degree of displacement and the corresponding synchronizing torque when the alternator is supplying full load at 0.8 p.f lag. [7]

6 a) Derive the commonly used expression for power developed by synchronous motor. [8]

b) A 15 kW, 3-phase, 400V star connected synchronous motor operating on full load from infinite bus bar, as its excitation so adjusted that the power factor is 0.8 lagging. Load being kept constant, excitation is now increased by 25%. Synchronous reactance is 1 per unit. Find the new power factor. [7]

7 a) Explain the various starting methods of synchronous motor. [8]

b) A 1000 HP, 6 kV, 3-phase, star connected synchronous motor has a synchronous impedance of (1.5+j16) ohms per phase. It is excited to develop an open circuit e.m.f of 5 kV. Draw the locus diagram of the current for loads up to 1250 HP with constant excitation. Determine the maximum value of the power factor. [7]

8 Explain working of AC series motor with necessary diagrams and mention its applications. [15]

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Code No: **R31025** **R10** **Set No. 2**

III B.Tech I Semester Supplementary Examinations, June/July - 2015

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) The constants of a 0.25 HP, 230 V, 4-Pole, 60 Hz, single phase induction motor are as follows: stator resistance, R_1=10 ohms; stator reactance, X_1=12.8 ohms; Rotor resistance referred to stator, R'_2=11.65 ohms; Rotor reactance referred to stator, X'_2=12.8 ohms; Magnetizing reactance, X_m=258 ohms. The total load is such that the machine runs at 3% slip, when the applied voltage is at 210 V. The iron losses are 35.5 W at 210 V. Calculate (i) input current and (ii) efficiency of the motor. [8]

b) Explain the double field revolving theory for operation of single phase induction motor. [7]

2 a) Derive the expression for EMF induced per phase in a 3-phase alternator. Mention how different winding factors affect the induced EMF. [8]

b) With neat sketch, describe constructional features and operation of salient pole alternator. [7]

3 a) Discuss briefly the load characteristics of alternator for different load power factors. [8]

b) What is synchronous impedance? How can it be measured in laboratory? [7]

4 a) Derive the expression for finding regulation of salient pole alternator using two reaction theory. Draw its phasor diagram. [8]

b) Describe the slip test method for measurement of X_d and X_q of synchronous machine. [7]

5 a) Discuss the phenomenon of sudden 3-phase short-circuit at armature terminals of an alternator. Draw the typical wave shape of the current and mark the different regions. [8]

b) Two alternators working in parallel supply a lighting load of 300 kW and a motor load aggregating to 5000 kW at a power factor of 0.71. One machine is loaded to 5000 kW at 0.8 power factor lagging. What is the load and power factor of the other machine? [7]

6 a) Explain the construction and principle of a synchronous motor? What are the advantages of it? [8]

b) A 2000 V, 3-phase star-connected synchronous motor has an effective resistance and synchronous reactance per phase of 0.2 ohms and 2.2 ohms respectively. The input is 800 kW at normal voltage and induced line e.m.f is 2500 V. Calculate line current and power factor. [7]

7 a) What is meant by constant power circle for synchronous motor? How is it derived? [8]

b) Give the connection diagram for starting of a synchronous motor using an auxiliary induction motor and outline the steps involved in the starting process. [7]

8 Explain the construction and principle of operation of universal motor and mention its applications. [15]

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Code No: **R31025** **R10** **Set No. 3**

III B.Tech I Semester Supplementary Examinations, June/July - 2015

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) Explain the construction, working principle and speed-torque characteristics of shaded pole induction motor. [8]

b) Draw the equivalent circuit of single phase induction motor with the help of double field revolving theory. [7]

2 a) Explain about the integral slot winding and fractional slot winding. Discuss their merits and demerits. [8]

b) A 3-phase, star connected, 4 pole, 1500 rpm alternator has 72 slots on its periphery. Each slot has 12conductors and winding is short pitched by 2 slots. Find pitch factor and distribution factor. Also, calculate induced EMF between lines if the flux of 0.04 Wb is distributed sinusoidally. All conductors in phase are connected in series. [7]

3 a) What are the causes of harmonics in the voltage waveform of an alternator? How can these be minimized? [8]

b) Explain the terms (i) leakage reactance (ii) synchronous reactance (iii) synchronous impedance. Explain the effect of synchronous impedance in the operation of a synchronous machine. [7]

4 a) Explain the Ampere-Turn method to find the voltage regulation of an alternator. [9]

b) A 3-phase, star connected salient pole synchronous generator is driven at a speed near synchronous with the field circuit open and the stator is supplied from a balanced 3-phase supply. Voltmeter connected across the line gave minimum and maximum readings of 1190 V and 1220 Volts. The line current fluctuated between 125 and 240 Amp. Find the direct and quadrature axis reactance per phase. Neglect armature resistances. [6]

5 a) A 4 MVA, 11 kV, 1500 rpm, 3-phase, and 50 Hz alternator is operating on infinite bus bar. Find synchronizing power per mechanical degree of angular displacement at (i) No-load (ii) Full-load at rated voltage and 0.8 pf lagging. [8]

b) Explain why primovers driving alternators operating in parallel should have drooping speed-load characteristics. [7]

6 a) Explain the effects of varying excitation on armature current and power factor in a synchronous motor. Draw 'V' curves and explain its significance. [8]

b) A 3-phase synchronous motor absorbing 60 kW is connected in parallel with a factory load of 240 kW having a lagging power factor of 0.8. If the combined load has a power factor of 0.9, what is the value of the leading kVAR supplied by the motor and at what power factor is it working. [7]

7 a) Draw the excitation circle for a synchronous motor. How is it derived? [8]

b) Why synchronous motor is not self starting? Explain the various starting methods of synchronous motor. [7]

8 With a neat diagram explain the principle of operation of a permanent magnet motor and mention its applications. [15]

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Code No: **R31025** **R10** **Set No. 4**

III B.Tech I Semester Supplementary Examinations, June/July - 2015

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) Explain the cross-field theory as applied to a single phase induction motor. [8]

b) A 125 W, 4 Pole, 110 V, 50 Hz, single phase induction motor delivers rated output at a slip of 6%. The total copper loss at full load is 25 W. Calculate the full load efficiency and the rotor copper loss caused by the backward field. Rotational losses may be assumed to be 25 W. Neglect stator copper losses. [7]

2 a) Explain how the induced EMF in armature winding is affected by: (i) Pitch factor (ii) Distribution factor. [8]

b) An 8 pole, 3-phase, 50 Hz, star-connected alternator with 15 slots and 28 conductors per slot. The flux per pole is 0.5 Wb and is sinusoidally distributed. Calculate the line e.m.f generated at 50Hz. [7]

3 a) Explain the various methods used for minimizing harmonics in the alternator. [8]

b) The phase e.m.f of a 3 phase, 50 Hz alternator consists of a fundamental, a 20% 3rd harmonic and a 10% 5th harmonic. The amplitude of the fundamental voltage is 1000V. Calculate the r.m.s line voltage when the alternators windings are in star and delta. If the reactance per phase at 50 Hz is 12 ohm, calculate circulating current when machine is delta connected. [7]

4 a) Explain the ZPF method to find the voltage regulation of an alternator. [7]

b) A 3-phase, star connected alternator is rated at 1600 kVA, 13500 V. The armature effective resistance and synchronous reactance are 2 ohms and 20 ohms respectively per phase. Calculate the percentage regulation for a load of 1200 kW at power factors of (i) 0.85 leading (ii) unity (iii) 0.85 lagging. [8]

5 a) Explain the effect of varying the excitation and torque of the prime-mover of synchronous machine connected to infinite bus-bar. [8]

b) Explain different synchronization methods used for synchronizing alternators. [7]

6 a) Draw the phasor diagram of a synchronous motor. Explain the effect (i) change of excitation if load is constant (ii) change of load if excitation is constant. [8]

b) A cylindrical rotor synchronous motor is used to improve power factor of a load of 4000 kW at a power factor of 0.8 (lag). The motor is required to meet an additional demand of 115 kW and to rise the overall power factor to 0.95 (lag). If the efficiency of the motor is 80 %, find its kVA rating and power factor. [7]

7 a) What are the effects of hunting on the performance of synchronous motor and explain the method of suppressing the hunting. [8]

b) Explain the construction and operation of synchronous induction generator. [7]

8 Describe the construction, working principle, characteristics and applications of a reluctance motor. [15]

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