SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:PUTTUR
(AUTONOMOUS)

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QUESTION BANK (DESCRIPTIVE)

Subject with Code : Electric Machines -III (20EE0215)
Course & Branch: B. Tech -EEE
Year & Semester: III- B. Tech. & I-Semester **Regulation:**R20

UNIT –I
SYNCHRONOUS GENERATORS

1	**a)**	Explain the principle of operation of a synchronous generator.	**[L2][CO1][6M]**
	b)	Compare between DC Generator and AC Generator	**[L3][CO1][6M]**
2		Explain the constructional details of the stator and types of rotors of an alternator.	**[L2][CO1][12M]**
3	**a)**	Explain the difference between the stationary armature and the rotating armature. What are the advantages of rotating armature over stationary armature?	**[L2][CO1][6M]**
	b)	Compare the difference between salient pole and non-salient rotor.	**[L3][CO1][6M]**
4		What are the various types of armature windings? Explain each of them with their importance.	**[L3][CO1][12M]**
5	**a)**	Write short notes on a) Pitch factor b) Distribution factor with relevant derivations	**[L3][CO1][6M]**
	(b)	For a 3 phase winding with 4 slots /pole /phase and with the coil span of 10 slot pitch, calculate the values of the pitch factor and distribution factor.	**[L3][CO1][6M]**
6	**a)**	Explain the integral slot and fractional slot winding of an alternator	**[L1][CO1][6M]**
	b)	An alternator is operating at no load has an induced EMF of 346.4 V/ph and a frequency of 60Hz. If the pole flux is decreased by 15% & the speed is increased by 6.8%; Determine i. the induced EMF ii. frequency	**[L3][CO1][6M**
7	**a)**	Derive the generalized EMF equation of an Alternator from fundamentals	**[L3][CO1][6M]**
	b)	A 3-phase, 50 Hz, 16 pole star connected alternator has stator winding with 144 slots with 10 conductors per slot. The magnetic flux/pole is 0.03 wb and is sinusoidally distributed in space. The coil pitch of the winding is 8 slots. Estimate the EMF induced between the lines of the alternator.	**[L2][CO1][6M]**
8		A 3-phase, 50 Hz, 16 pole star connected alternator has stator winding with 144 slots with 10 conductors per slot. The flux per pole is 0.04 wb and is distributed sinusoidally. The speed is 375 rpm. Find the frequency, phase EMF, and line EMF. The coil span is 120 degree electrical.	**[L2][CO1][12M]**
9	**a)**	A 3-phase, 6 pole star connected alternator revolves at 1000 rpm. The stator has 90 slots and 8 conductor per slot. The flux per is 0.05 wb. Calculate the voltage generated by the machine if the winding factor is 0.96	**[L2][CO1][7M]**
	b)	An 8 pole, 3 phase 60 degree spread double layer winding has 72 coils in 72 slots. These coils are short pitched by two slots. Calculate the winding factor for the fundamental and third, fifth harmonics.	**[L3][CO1][5M]**

10	**a)**	Define harmonics and what are the various causes of producing harmonics in induced EMF?	**[L3][CO1][6M]**
	b)	What are the effect of harmonics on induced EMF and winding factors and how they are suppressed?	**[L4][CO1][6M]**

UNIT –II

REGULATION OF SYNCHRONOUS GENERATORS

1	**a)**	Define a) Armature resistance b) Leakage reactance c) synchronous reactance e) Synchronous impedance	**[L4][CO2.[6M]**
	b)	What is the armature reaction in alternators? Explain it for different power factors conditions.	**[L3][CO2][6M]**
2	**a)**	State and explain the voltage equation of an alternator	**[L2][CO2][6M]**
	b)	Define the voltage regulation of an alternator. Explain the various factors, which may affect the regulation of an alternator	**[L2][CO2][6M]**
3	**a)**	A three-phase star-connected alternator is rated at 1500 kVA, 1200V. The armature effective resistance and synchronous reactance are 2 Ω and 35 Ω respectively per phase. Calculate the percentage regulation for a load of 1200 kW at a power factor of 0.8 lagging.	**[L4][CO2][6M]**
	b)	Explain the procedure for calculation voltage regulation by synchronous impedance method with phasor diagram	**[L2][CO2][6M]**
4		The open circuit and short circuit test is conducted on 3-phase star-connected 866V, 100 kV alternator. The O.C test results are: The field current of 1A produces a short circuit current of 25A. The armature resistance per phase is 0.15 Ω. Calculate its full load regulation at 0.8 lagging power factor condition. I_f (A) | 1 | 2 | 3 | 4 | 5 | 6 V_{oc}(V) | 173 | 310 | 485 | 605 | 728 | 790	**[L4][CO2][12M]**
5		The open and short circuit test readings for a 3 phase star connected, 1000 kVA, 2000V, 50Hz, synchronous generator are: The armature effective is 0.2 Ω per phase. Draw the characteristics curves and estimate full load percentage regulation (a) 0.8 pf lagging (b) 0.8 leading. Use the MMF method. V_{oc}(V) | 800 | 1500 | 1760 | 2000 | 2500 | 2600 I_{sc} (A) | --- | 200 | 250 | 300 | --- | ---- I_f (A) | 10 | 20 | 25 | 30 | 40 | 50	**[L3][CO2][12M]**
6		Explain the procedure for the construction of the Potier triangle by ZPF method and How do you calculate the no-load voltage and voltage regulation with a phasor diagram?	**[L2][CO2][12M]**

7		An 11KV, 1000 KVA, 3-Φ star connected alternator has a resistance of 2Ω/phase. The O.C and Full load ZPF characteristics are given below. Find the voltage regulation of an alternator for FL current at 0.8PF Lagging by the Potier method. I_f (A) 40 50 110 140 180 V_{oc}(V) 5800 7000 12,500 13,750 15,000 V_{zpf}(V) 0 1500 8500 10,500 12,500	**[L3][CO2][12M]**
8	**a)**	Describe the ASA method of calculating voltage regulation.	**.[L2][CO2][7M]**
	b)	Explain the significance of the short circuit ratio for finding voltage regulation.	**[L2][CO2][5M]**
9	**a)**	Define the voltage regulation of an alternator. Explain the various factors, which may affect the regulation of an alternator.	**[L1][CO3][6M]**
	b)	Describe the slip test method for the measurement of X_d and X_q of synchronous machine.	**[L2][CO3][6M]**
10		Explain the terms direct axis and quadrature axis synchronous reactance of a salient pole alternator using two reaction analysis?	**[L2][CO3][12M]**

UNIT –III

PARALLEL OPERATION OF SYNCHRONOUS GENERATORS

1	**a)**	What is infinite bus bar? Explain synchronization of alternator with infinite bus bar	**[L1][CO3][6M]**
	b)	Explain necessity of parallel operation of alternators	**[L2][CO3][6M]**
2		Derive the expression for power developed of an alternator connected to infinite bus bar with Power angle characteristics	**[L2][CO3][12M]**
3	**a)**	Explain the effect of change in excitation and mechanical power input of an alternator.	**[L2][CO3][4M]**
	b)	Derive the expression for synchronizing current, synchronizing power and synchronizing torque.	**[L2][CO3][8M]**
4		A 5MVA, 10KV, 1500rpm, 50HZ alternator runs in parallel with other machines. Its reactance drop is 20%. Find a) No load b) Full load at 0.8PF lagging, the synchronizing power per unit mechanical angle of phase displacement and calculate the synchronizing if the mechanical displacement is 0.5.	**[L3][CO3][12M]**
5		What is meant by synchronization of alternators? Discuss any two methods of synchronization of alternator.	**[L1][CO3][12M]**
6	**a)**	Derive the expression for circulating current for dissimilar alternators connected by a common load.	**[L2][CO3[6M]**

	b)	Two 1-phase alternators operating in parallel have induced EMF's on open circuit of $220 < 0°$ and $220 < 10V$ and respective reactance's of 3J and 4J Ω. Calculate the i) terminal voltage, ii) currents and iii) power delivered by each of the alternators to a load resistance of 6 Ω	**[L4][CO3[6M]**
7		A 5000 KVA, 10 kV, 1500 RPM, 50Hz, alternator runs in parallel with other machines. Its synchronous reactance is 20%. Find for a) no load, b) full load at power factor 0.8 lagging, and synchronous power per unit mechanical angle of phase displacement and calculate the synchronous torque, if the mechanical displacement is 0.5°.	**[L3][CO3][12M]**
8	**a)**	Explain synchronizing alternator with infinite bus bar.	**[L2][CO3][6M]**
	b)	Determine Sub transient, Transient and steady state reactance of synchronous machine experimentally.	**[L3][CO3][6M]**
9		a) List out the conditions for parallel operation of alternators. b) What are the methods used for synchronization of alternators. c) Write the formulae for power developed per phase of an alternator connected to an infinite busbar. d) Draw the power angle characteristics of synchronous machine. e) Define synchronizing current.	**[L1][CO3][12M]**
10	**a)**	Show that for alternators running in parallel, the division of load between them is governed mainly by the speed load characteristics of their prime movers?	**[L2][CO3][6M]**
	b)	Two 3-phase synchronous mechanically coupled generators operate In parallel on the same load. Determine the kW output and pf of each machine under the following conditions. The synchronous impedance of each generator 0.2+j0.2 ohm/phase. Equivalent impedance of the load 3+4J ohm/phase. Induced emf per phase 2000+j0 volt for machine I and 22000+J100 for II.	**[L3][CO3][6M]**

UNIT-IV

Synchronous Motors-I

1	**a)**	Explain the construction and working principle of a synchronous motor.	**[L2][CO5][8M]**
	b)	Why synchronous motor is not self-starting. Explain in detail.	**[L4][CO5][4M]**
2		Derive the expression for induced or back EMF per phase at different power factors in the phasor diagram.	**[L3][CO5][12M]**
3	**a)**	Explain the power flow equation of synchronous motor	**[L2][CO5][7M]**
	b)	A three-phase 500V star-connected synchronous motor gives a net output of 17 kW on full load operating at 0.9 lagging power factor. Its armature resistance is 0.8 Ω per phase. The mechanical losses are 1300 W. Estimate the current drawn by the motor and full load efficiency.	**[L4][CO5][5M]**
4	**a)**	Explain the behavior of the synchronous motor on loading.	**[L2][CO5][6M]**

	b)	Explain the behavior of synchronous motor on no load (with losses)	**[L2][CO5][6M]**
5	**a)**	Explain the condition for maximum power and the value of maximum power for synchronous motors.	**[L2][CO5][8M]**
	b)	Explain the power flow diagram in a synchronous motor.	**[L2][CO5][4M]**
6	**a)**	A 400V, 3-phase star-connected synchronous motor has an armature resistance of 0.2 Ω per phase and synchronous motor reactance of 2 Ω per phase. While driving a certain load it takes 25A from the supply. Calculate the back e.m.f induced in the motor if it is working with i) 0.8 lagging ii) 0.9 leading iii) at UPF	**[L3][CO5][8M]**
	b)	What are the advantages and disadvantages of synchronous motors?	**[L1][CO5][4M]**
7		Explain the operation of a synchronous motor at constant load variable excitation with neat phasor diagrams.	**[L2][CO5][12M]**
8		Explain the laboratory setup to obtain V and inverted V curves	**[L2][CO5][12M]**
9	**a)**	Explain the V and inverted V curves of the synchronous motor.	**[L2][CO5][8M]**
	b)	A 3-phase 11000V, the star-connected synchronous motor takes a load current of 100A. The effective synchronous reactance and resistance per phase are 30 Ω and 0.8 Ω respectively. Find the power supplied to the motor and induced EMF for 1) 0.8 p.f lag 2) 0.8 p.f lead.	**[L4][CO5][4M]**
10	**a)**	A 3-phase, 500V star-connected synchronous motor gives a net output of 17kW on full load operating at 0.9 lagging power factor. Its armature resistance is 0.8 Ω per phase. The mechanical losses are 1300W. Estimate the current drawn by the motor and full load efficiency.	**[L4][CO5][6M]**
	b)	What is a synchronous condenser? What is the use of a synchronous condenser with a neat phasor diagram?	**[L1][CO5][6M]**

UNIT-V

Synchronous Motors-II

1	**a)**	What is hunting? State its causes and how it can be minimized. Explain the use of damper winding in a synchronous motor.	**[L1][CO6][12M]**
2	**a)**	Define various torques associated with synchronous motors.	**[L1][CO6][6M]**
	b)	Explain the procedure for starting a synchronous motor.	**[L2][CO6][6M]**
3	**a)**	Explain the applications of synchronous motors.	**[L2][CO6][4M]**
	b)	State the methods of starting the synchronous motor. Explain any two detail.	**[L1][CO6][8M]**
4		Explain the constant excitation circles and constant power circles for a synchronous motor.	**[L2][CO6][12M]**
5		Explain the operation of a synchronous motor.at constant load variable excitation with a neat phasor diagram.	**[L2][CO6][12M]**

6	**a)**	Discuss the disadvantages of low power factor and explain the use of synchronous condenser in power factor improvement.	**[L2][CO6][6M]**
	b)	An industrial load of 800 kW is operating at 0.6 lagging power factor. It is desired to improve the factor to 0.92 lagging by connecting a synchronous motor driving load of 200 kW with an efficiency of 91%. Determine the KVA rating of the synchronous motor and the power factor at which it is operating.	**[L3][CO6][6M]**
7	**a)**	Explain the construction and operation of a synchronous induction motor.	**[L2][CO6][8M]**
	b)	Explain the advantages and disadvantages of a synchronous induction motor.	**[L2][CO6][4M]**
8	**a)**	Draw and explain the phasor diagram of a synchronous motor operating at lagging and leading power factor.	**[L1][CO6][6M]**
	b)	Discuss the performance characteristics of a synchronous induction motor.	**[L2][CO6][6M]**
9	**a)**	Estimate the procedure for estimation of load current in a synchronous induction motor.	**[L2][CO6][7M]**
	b)	Explain the comparison of synchronous and induction motors.	**[L2][CO6][5M]**
10		A 3-phase, 3300V, star-connected synchronous motor has an effective resistance and synchronous reactance of 2 Ω and 18 Ω per phase respectively. If the open circuit generated e.m.f is 3800 V between lines, calculate i) The maximum total mechanical power that the motor can develop and ii) The current and power factor at the maximum mechanical power.	**[L3][CO6][12M]**

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