

5. (a) Draw the schematic representation of series, shunt and long-shunt compound generators. In each case, write the voltage balance and current balance equations. (6 Marks)
- (b) Give reasons:
- The armature winding is placed on the rotor in a dc machine.
 - Shunt motors are used for constant speed applications.
 - Series motors should not be started without proper load. (6 Marks)
- (c) A 6-pole, dc shunt motor has a lap-connected armature with 492 conductors. The resistance of the armature is 0.2Ω and the flux per pole is $50mWb$. The motor runs at 20 revolutions per second when it is connected to a $500V$ supply for a particular load. What will be the speed of the motor when the load is reduced by 50%. Neglect contact drop and magnetic saturation. (8 Marks)
6. (a) What are the main parts of a transformer? What is the function and the main material of construction in each case? (6 Marks)
- (b) With respect to a transformer, give reasons for the following:
- there is small primary current even when the load is not connected.
 - the core losses are constant for any load.
 - there is an inrush of current in the primary when the secondary is loaded. (6 Marks)
- (c) Define the power efficiency and regulation of a transformer. The maximum efficiency at full load and unit power factor of a single-phase 25kVA, 500/1000 V, 50 Hz, transformer is 98%. Determine its efficiency at
- 75% load, 0.9pf; and ii) 50% load, 0.8pf. (8 Marks)
7. (a) What are salient and nonsalient synchronous machines? Give any two characteristic features of each of them. (6 Marks)
- (b) Explain the terms: pitch factor, distribution factor, and voltage regulation of an alternator. (6 Marks)
- (c) A 24-pole turbo alternator has a star connected armature winding with 144 slots and 10 conductors per slot. It is driven by a low speed Kaplan turbine at a speed of 250 revolutions per minute. The winding has full-pitched coils with a distribution factor of 0.966. The flux per pole is $67.3mWb$. Determine
- the frequency and the magnitude of the line voltage;
 - the output kVA of the machine if the total current in each phase is 50A. (8 Marks)
8. (a) Define synchronous speed, slip speed, and motor speed of a three-phase induction motor. Explain why the induction motor cannot run at synchronous speed. (6 Marks)
- (b) Why is a starter required for starting a 3-phase induction motor? Explain how a star-delta starter helps in safe starting of the motor. (6 Marks)
- (c) The rotor-induced voltage of a three-phase, 4-pole squirrel cage induction motor fed by a salient pole alternator is observed to make 1.5 alternations per second. The star connected alternator with 592, full-pitched armature conductors in series per phase with a distribution factor of 0.966 develops a line voltage of 6600 volts when the flux per pole is $60mWb$. Determine the speed of the induction motor. (8 Marks)

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