**Unit 5 - Synchronous Machines**

1. **What are the merits of computer aided design?**
   i) Good performance that fits into the technical specification.
   ii) Permissible cost of the machine from the customer point of view
   iii) Higher operating range and suitable for multi tasking
   iv) Easy maintenance and simple in construction.

2. **What is run away speed?**
   The runaway speed is defined as the speed which the prime mover should have if it is suddenly unloaded, when working at its rated load.

3. **What are the constructional differences between salient pole alternator and cylindrical rotor type alternator?**
   The term **salient pole** means projected pole.
   i. This type of rotor is used for low and medium speed machines. The prime mover is used is water turbine which gives low speed 50 to 500rpm.
   ii. In order to get standard frequency 50Hz, the no of poles lies in the range 12 10 120.
   iii. Because of low speed such machines are characterized by large diameter and small length.
   iv. Since water turbine is used as a prime mover type of alternator is also called hydro electric generator.
   **Cylindrical pole rotor:** since the structure is cylindrical and cross section is a circle, it is called cylindrical pole rotor. This type of rotor is used for high speed machine.

4. **How the computer is aided design different from conventional design in the case of electrical apparatus.**
   i. Easy to access
   ii. Reduced time for design
   iii. Accuracy.

5. **How Cylindrical pole different from salient pole in asynchronous machine?**
   i. Cylindrical pole are non projecting pole whereas the salient pole machine are projecting pole.
   ii. Cylindrical rotor construction is used for turbo alternators which are driven by high speed steam or gas turbines where as salient pole construction is used for generators driven by hydraulic turbine since these turbines operate at relatively low speeds.

6. **Define short circuit ratio (SCR) of a synchronous generator.**
   \[ \text{SCR} = \frac{1}{X_d} \]
   Large SCR result in a good regulation, good stability and large \(I_{sc}\)

7. **What are the prime movers used for a) salient pole b) Non salient pole alternator?**
   - The prime movers used for salient pole alternators are water wheels like Kaplan turbine, Francis turbine, Pelton wheel etc. and diesel and petrol engines.
   - The prime movers used for non salient pole alternators are steam turbines and gas turbines.

8. **What is critical speed of Alternator?**
When the rotor of the alternator has an eccentricity, it may have a deflection while rotating. This deflection will be maximum at a speed called critical speed. When rotors with eccentricity pass through critical speed, severe vibrations are developed.

9. **Mention the uses of damper winding in a synchronous machine.**
   i) The damper winding is used to reduce the oscillations developed in the rotor of alternator when it is suddenly loaded.
   ii) The damper winding is used to start the synchronous motor as an induction motor.

10. **List the factors to be considered for separation of D and L for salient pole machines.**
    In synchronous machines the separation of D and L depends on the following factors:
    a. Peripheral speed
    b. Number of poles
    c. Short circuit ratio (SCR)

11. **State the factors for separation of D and L in cylindrical rotor machine.**
    The separation of D and L in cylindrical rotor machine depends on the following factors:
    a. Peripheral speed
    b. Number of poles
    c. Short circuit ratio (SCR)

12. **Why alternators are rated in KVA?**
    The KVA rating of ac machine depends on power factor of the load. The power factor in turn depends on the operating conditions. The operating conditions differ from place to place. Therefore the KVA rating is specified for all ac machines.

13. **What are the factors to be considered for the choice of specific magnetic loading in synchronous machine?**
    The factors to be considered for the choice of specific magnetic loading are i) iron loss, ii) stability, iii) Voltage rating, iv) parallel operation and v) Transient short circuit current.

14. **List the factors to be considered for the choice of specific magnetic loading in synchronous machine?**
    The factors to be considered for the choice of specific electric loading are i) copper loss, ii) synchronous reactance, iii) Temperature rise, iv) stray load losses and v) voltage rating.

15. **List the factors to be considered for the choice of number of slots in synchronous machine?**
    The factors to be considered for the choice of number of slots are i) balanced winding, ii) leakage reactance, iii) cost, iv) tooth losses, v) hot spot temperature in winding and vi) tooth flux density.

16. **Determine the total number of slots in the stator of an alternator having 4 poles, 3 phase 6 slots per pole for each phase.**
    Total number of slots = slots per pole X number of poles X number of phase
    $$6 \times 4 \times 3 = 72 \text{ slots}$$

17. **Mention the factors that govern the design of field system of alternator.**
    The following are the factors to be considered for the design of field system in alternator i) number of poles ii) Amp turn per pole iii) copper loss in field coil iv) dissipating surface of field coil v) specific loss dissipation and allowable temperature rise.

18. **What are the types of computer aided design methods of electrical machines?**
i. Analysis Method
ii. Synthesis Method
iii. Hybrid Method

19. Give the allowable peripheral speed of salient pole alternator for different types of pole fixing.

<table>
<thead>
<tr>
<th>Type of Pole fixing</th>
<th>Allowable peripheral speed</th>
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<tbody>
<tr>
<td>Bolted on pole construction</td>
<td>50 m/s</td>
</tr>
<tr>
<td>Dove tailed &amp; T-head construction</td>
<td>80 m/s</td>
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20. Write down the expression for the length of airgap at pole face of salient pole alternator.

The length of air gap at a distance ’x’ from centre is,

\[ l_{gx} = \frac{l_g}{\cos\left(\frac{\pi x}{\tau}\right)} \]

Normally, a constant air gap of 0.1 to 0.25\(\tau\) may be maintained at the centre and then beveled to get 1.5 to 2.25\(\tau\) at the tips of pole shoe.

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