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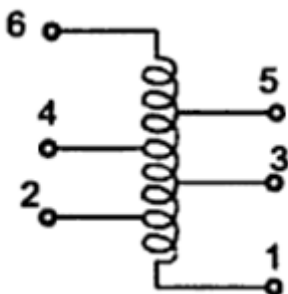
**One mark/blank questions:**

1. A DC motor drives a 100kW generator having an efficiency of 87%; if the overall efficiency of the motor-generator set is 74%, the efficiency of the motor is \_\_\_\_\_. Power loss in motor will be \_\_\_\_\_.
2. The number of parallel paths in the armature winding of a four-pole wave-connected DC machine having 22 coil sides are \_\_\_\_\_.
3. Compensating winding in DC motors are series excited for cancelation of \_\_\_\_\_ at any load.
4. A transformer when supplying a load maintained 11 kV across load terminals. When the load was switched off, the terminal voltage became 11550 volts. The voltage regulation at this load is \_\_\_\_\_.
5. A synchronous motor is operating at constant load while its excitation is adjusted to give unity power factor current. If the excitation is now increased, the power factor will be \_\_\_\_\_. (lagging/leading/unity)
6. A synchronous motor is operated from a source voltage of one per unit and is drawing one per unit, zero power factor leading current, its synchronous reactance is 0.5 per unit. The excitation e.m.f. of motor will be \_\_\_\_\_.
7. For thermal power plants and hydro power plants generally \_\_\_\_\_ and \_\_\_\_\_ type of synchronous generators are used respectively.
8. For starting a synchronous motor, a squirrel cage rotor is generally preferred. In this method of starting, the field winding is \_\_\_\_\_ and the motor starts as \_\_\_\_\_.
9. A three phase transformer has its primary connected in star and secondary in delta. The secondary to primary turns ratio per phase is 5. For a primary line voltage of 400 volts, the secondary line voltage will be \_\_\_\_\_.
10. In a delta connection of three single-phase transformers, if one transformer becomes disabled, the loading capacity of the configuration will reduce to \_\_\_\_\_.
11. In a star-delta transformer, the phase difference between line voltages of two sides will be \_\_\_\_\_ and the phase difference between line currents of two sides will be \_\_\_\_\_.
12. Two transformers connected in parallel, share loads in the ratio of their KVA rating provided their ohmic impedances are \_\_\_\_\_ of their rating.
13. If the voltage bases are selected in the ratio of transformation, the pu impedance of the transformer is .....(same/different) on either side.
14. In a synchronous machine, if  $E_f \cos \delta < V_t$ , the machine is \_\_\_\_\_ excited(Over/under).
15. For an AC circuit,  $v = V_{max} \sin(\omega t + \alpha)$  Volts and  $i = I_{rms} \sqrt{2} \cos(\omega t + \beta)$  Amp. Power factor of the circuit is \_\_\_\_\_.
16. The nature of flux produced by the stator of a three phase machine if only one of the three-phases is connected to AC source, is \_\_\_\_\_ (stationary/rotating)and \_\_\_\_\_ (pulsating/DC).
17. The power factor of an alternator under short circuit conditions is almost near \_\_\_\_\_ 0 Lagging.
18. A 220 kVA autotransformer is made using a 20 kVA two winding equivalent transformer. The rated conducted and transformed power for autotransformer are \_\_\_\_\_ kVA and \_\_\_\_\_ kVA respectively.

(24 marks total)

Two marks/blank questions:

19. In a permanent magnet synchronous motor, the magnet used has residual flux density of 1.2 T and its depth inside rotor is 20 mm, and relative permeability is 1.08. If air-gap is of 3 mm, then the flux density established in the air gap/magnet will be \_\_\_\_\_ T.
20. A single-phase transformer supplies a load at  $1/\sqrt{2}$  pf leading such that the voltage regulation is zero. The ratio of copper loss to reactive power of transformer circuit is \_\_\_\_\_.
21. A 3-phase, 400 V, 50 Hz, synchronous motor is operating with a load angle of  $20^\circ$ , with excitation voltage equal to terminal voltage. The synchronous reactance drop in terms of excitation voltage is \_\_\_\_\_%. ( $R_a$  is negligible)
22. An Industrial 3-phase load draws an average current of 125 A at 0.8 lagging pf from the secondaries of 120 kVA, 2000/200 V, Star/Delta transformer (made up by using three identical two-winding transformers). The voltage rating of the two-winding transformer unit will be \_\_\_\_\_, the phase current in the primary of the transformer is \_\_\_\_\_ Amperes and the line current drawn from the supply will be \_\_\_\_\_ Amperes.
23. A three-phase induction motor has delta-connected stator winding. Its starting current per phase is 64 A when started directly on the line (DOL). The line current in DOL starting will be \_\_\_\_\_ A, the motor line current and supply line current in case of autotransformer starting (with 75% tapping) will be \_\_\_\_\_ A, and \_\_\_\_\_ A respectively.
24. A 4-pole, 50 Hz, 1440 rpm three-phase induction motor has maximum torque of 60 Nm at a speed of 1320 rpm. The slip at maximum torque will be \_\_\_\_\_, and the full load torque will be \_\_\_\_\_ Nm.
25. A 6-pole, 50 Hz, 6 kW, 940 rpm three-phase squirrel cage induction motor has friction and windage losses as 900 W. At full load, the slip will be \_\_\_\_\_, and the gross electromechanical torque developed will be \_\_\_\_\_ Nm.
26. A 20 kW, 4-pole, 50 Hz, 3-phase slip ring induction motor is running at 1425 rpm and its rotor current is 40 A/phase. Rotational losses (friction and windage) are 800 W and rotor resistance is 0.15 ohm/phase. The slip will be \_\_\_\_\_, rotor copper losses will be \_\_\_\_\_ W, and external resistance added in rotor circuit will be \_\_\_\_\_ ohm/phase.
27. Draw neat connection diagrams for cumulative and differential compound DC machines in long shunt category.
28. Draw switching sequence for on load tap changing from tap 4 to tap 5.



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**Note:** (i) All the questions **MUST** be answered in sequence in answer sheet (ii) Q 1, 2 and 3 are of 12 Marks each and Q.4 is of 9 Marks (iii) Assume suitable data, if necessary.

Q.1. A 230 V, 4-pole, 50 Hz single-phase induction motor has following equivalent circuit parameters:

$$R_1 = 2.8\Omega, X_1 = 3.8\Omega, X_m = 82\Omega, R_2' = 4.8\Omega, X_2' = 3.6\Omega$$

The core losses are 32 W and friction & windage losses are 18 W. At the full load slip of 0.04, find (a) total impedance of the motor (b) the input current of the motor (c) the power factor at the input (d) net mechanical power output (e) speed at full load (f) net output torque (g) efficiency.

Q2. A 1MVA, 2400V, 60Hz, 3 phase, star connected synchronous generator has an armature resistance of  $0.5 \Omega$ /phase. A field current of 30 A at the rated speed produces a short circuit current of 277 A and an open circuit line voltage of 2400 V.

- Calculate the value of synchronous reactance
- Calculate the value of excitation EMF at full load and 0.707 power factor lagging.
- Calculate the value of voltage regulation for the parameters given in (b)
- While supplying the same real power as in part (b), the machine excitation is raised by 15%, determine the stator current, power factor and torque angle.

Q.3 A 6600/400 V, 100 kVA distribution transformer is connected delta/star. The transformer has 0.012 pu resistance and 0.05 pu reactance. (a) Find the voltage regulation at full load 0.8 pf leading. (b) Determine the primary voltage when full load at 0.8 pf leading is connected on 400 V side (c) Determine the efficiency at the same load considering only copper losses.

Q.4 It is observed that while starting a DC motor in our laboratory experiment (generally during no load test), two different external resistances are connected. (a) Identify the type of motor used in experiment (b) In which part of the motor circuit these two different external resistances are connected and why? (c) Draw proper diagram of this arrangement (*Do not draw measuring instruments*). (d) Out of these two external resistances, which one is of higher value?

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