

### **Part I: Answer the following questions clearly and neatly**

1. What is the difference between motor and generator and what are the main parts of both of them?
2. What is energy balance?
3. What are the disadvantages of autotransformer?
4. Write at least 4 main differences between transformer and autotransformer.
5. What are the conditions for parallel operation of transformer?
6. Define clearly what is voltage regulation of a transformer
7. Draw the diagram of step up and step down autotransformer clearly with its definition
8. Write briefly the working principle of three-phase induction motor.
9. List and define clearly the types of rotor in induction motor.
10. What is Intrinsic and Extrinsic semiconductor mean?
11. Explain briefly the terms Insulators, Conductors, and Semiconductors with their examples.
12. What is depletion layer mean and how it forms?
13. Depending on the polarity of the voltage applied and the gate pulse given to the SCR, it can operate in three different modes. What are these and define them clearly.

### **Part II: Show all the necessary steps clearly**

14. The total magnetic flux out of a cylindrical permanent magnet is found to be 0.032 mWb. If the magnet has a circular cross section and a diameter of 1 cm, what is the magnetic flux density at the end of the magnet?
15. A 480 V, 50 hp, three phase induction motor is drawing 60 A at 0.85 pf lagging. The stator copper losses are 2 KW and the rotor copper losses are 700 W. The friction loss is 600 W and the core losses are 1800 W, find:
  - a. The air gap power
  - b. The converted power

- c. The output power
- d. The efficiency of the motor.

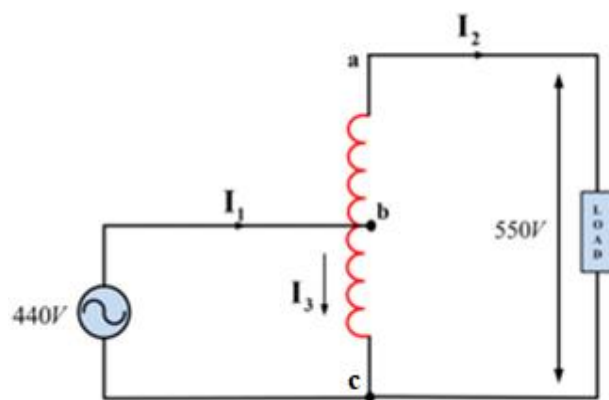
**16. A single-phase transformer has the following parameters:**

|                   |                 |                   |                   |                  |
|-------------------|-----------------|-------------------|-------------------|------------------|
| $R_1 = 0.3\Omega$ | $X_1 = 2\Omega$ | $R_c = 6K\Omega$  | $N_1 = 400$ turns | $Z_L = 20\Omega$ |
| $R_2 = 1.5\Omega$ | $X_2 = 4\Omega$ | $X_m = 150\Omega$ | $N_2 = 800$ turns |                  |

- I. Draw the complete equivalent circuit without approximation**
- II. Draw the approximate equivalent circuit referred to the primary ignoring the excitation component.**
- III. Draw the approximate equivalent circuit referred to the secondary ignoring the excitation component.**

**17. A single-phase, 10-kVA, 440/110-V, two-winding transformer is connected as an autotransformer to supply a load at 550 V from a 440 V supply. Calculate**

- a) KVA rating as an autotransformer**
- b) Apparent power transferred by conduction**
- c) Apparent power transferred by electromagnetic induction**



**18. Find the values of A,B,C,D,E,F,G, and H in the table shown below with clear step**

| Primary Voltage | Secondary Voltage | Primary Turns | Secondary Turns | Turn ratio (a) |
|-----------------|-------------------|---------------|-----------------|----------------|
| 250             | A                 | 50            | B               | 5              |
| C               | 240               | D             | 48              | 0.25           |
| E               | 600               | 45            | F               | 0.05           |
| 1200            | G                 | H             | 1800            | 0.5            |

19. A 400 V, three-phase, 50 Hz, 2-pole, star-connected induction motor runs at 48.5 rev/s on full load. The rotor resistance and reactance per phase are  $0.4\ \Omega$  and  $4.0\ \Omega$  respectively, and the effective rotor-stator turns ration is 0.8:10. Calculate

- the slip, (Ans 0.03)
- the full load torque, (Ans 22.43 N.m)
- the maximum torque, (Ans 40.74 N.m)
- the speed at which maximum torque occurs,(Ans 2700 rpm)
- The starting torque.(Ans 8.07 N.m)

- f) the rotor current, (Ans 13.27A)
- g) the rotor copper loss, and (Ans 211.3W)
- h) The starting current. (Ans 45.96A)

20. The power supplied to a three-phase induction motor is 50 kW and the stator losses are 2 kW. If the slip is 4%, determine

- a. the rotor copper loss, (1.92 kW)
- b. the mechanical power developed by the rotor, (46.08)
- c. the output power of the motor if friction and windage losses are 1 kW, and (45.08)
- d. The efficiency of the motor, neglecting rotor iron losses.  
(90.16%)