Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2024

Programme Name: B.TECH.(NAOE) & B.TECH.(NASB)

Semester: II

Subject Code: UG12T2204 / UG13T1204

Subject Name: Basic Electrical Engineering

Date: 05.06.2024	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.
(iii) Scientific Calculator is permitted.

Section A

Ten MCQs/Fill in the Blanks of One Mark each – Choose the correct answer.
Objective Questions (MCQ/True or False/Fill in the blanks/Match the follow
10 X 1 = 10 Marks

1. For a series D.C. motor which of the following is correct about the armature torque?

(a) $T_a \propto I_a$
(b) $T_a \propto I_a^2$
(c) $T_a = k$
(d) $T_a \propto \frac{\Phi}{I_a}$

2. While solving any circuit using nodal analysis, the system of linear equations are obtained in terms of

(a) branch current
(b) mesh current
(c) mesh voltage
(d) node voltage

3. For a self-excited D.C. generator, the series-field and shunt-field winding resistances are R_{se} and R_{sh} respectively. Which of the following relationship is correct?

(a) $R_{se} < R_{sh}$
(b) $R_{se} > R_{sh}$

(c) $R_{se} = R_{sh}$
(d) $R_{se} < \frac{R_{sh}}{2}$

4. Which pair of circuits in Fig. Q-3 are equivalent?

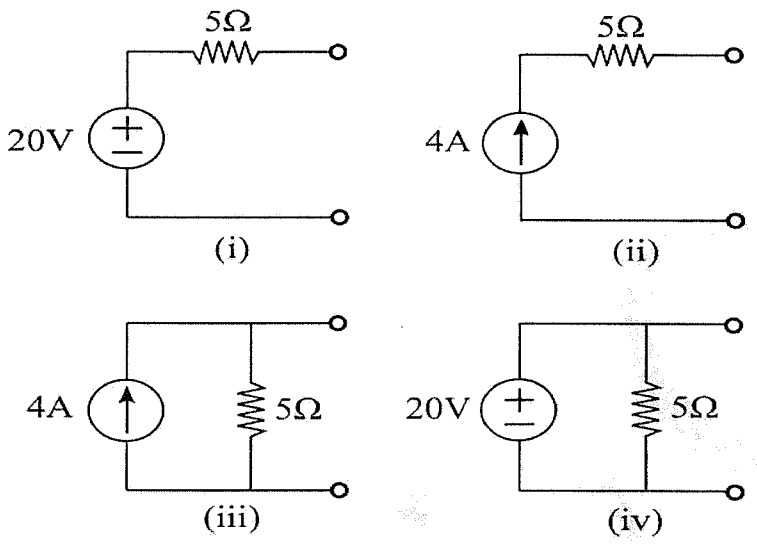

Fig. Q-3

(a) (i) and (ii)
(b) (ii) and (iv)
(c) (i) and (iii)
(d) (iii) and (iv)

5. In a DC machine, which part is responsible for converting electrical energy into mechanical energy?

(a) Field winding
(b) Brushes
(c) Armature
(d) Commutator

6. Which of the following component of a D.C. motor is used to change the direction of current in armature windings? What is the role of the commutator in a DC motor?

(a) Commutator
(b) Slip rings
(c) Brushes
(d) Poles

7. In a balanced three-phase system, what is the phase angle difference between the line voltages?

(a) 120^{o}
(b) 90^{o}
(c) 60^{o}

(d) 30^{o}

8. What is the voltage transformation ratio of a voltage transformer if the primary voltage is 250 *V*, and the secondary voltage is 3000 *V*?

(a) 10
(b) 11
(c) 12
(d) 13

9. What is the main purpose of an iron core in a transformer?

(a) To generate electricity
(b) To improve energy efficiency
(c) To reduce the weight of the transformer
(d) To provide a path for magnetic flux

10. In a hydrogen fuel cell, what is the by-product of the electrochemical reaction that generates electricity?

(a) Carbon dioxide
(b) Water
(c) Methane
(d) Nitrogen

Section B

Five Short Answer type Questions of Two marks each.
5 X 2 = 10 Marks

11. Draw a neat and clean circuit diagram of a short-shunt D.C. compound generator.

12. For a linear resistive circuit, sketch the power delivered to a load as a function of the load resistance. Mention the following on the sketch:

(a) Condition of the maximum power delivered to the load.

(b) Maximum power delivered to the load.

13. Draw the torque versus armature current characteristics for a D.C. series and shunt motor.

14. Why a starter is required?

15. What is Kirchhoff's Voltage Law?

Section C

Seven Long Answer type Questions of Two marks each. Answer any Five.
10 X 5 = 50 Marks

16. For the circuit in Fig. Q-16:

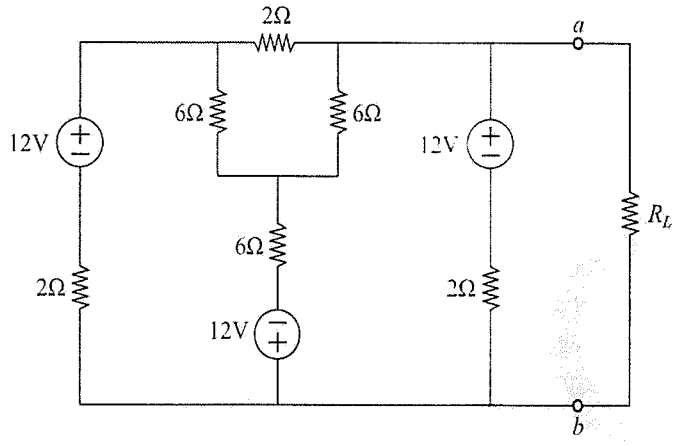

Fig. Q-16

(a) Obtain the Thevenin equivalent at terminals *a-b*.

(7 Marks)

(b) Find R_L for maximum power deliverable to R_L.

(1 Mark)

(c) Determine the maximum power that can be delivered to the load resistor, R_L.

(2 Marks)

17. Explain the construction and working of a DC motor.

18. What is a Fuel cell? Explain the construction and working of a Fuel cell.

19. A 4-pole D.C. series motor running at a speed of 600 r.p.m. on full load taking 25 *A* at 450 *V*. The armature is lap-wound with 500 conductors and flux per pole is expressed by the relation.

$$\Phi = \left(1.7 \times 10^{-2} \times \sqrt{I}\right) weber$$

where I is the motor current. If the supply voltage and torque are both halved, calculate the speed at which the motor will run.

20. What is the working principle of a transformer? Explain the construction and working of an ideal transformer using a neat and clean diagram.

21. What is squirrel cage induction motor? What is the working principle of squirrel cage induction motor? Explain its construction using a neat and clean circuit diagram.

22.

(i) An 8-pole, long-shunt wave-wound D.C. generator supplies 25 *kW* at a terminal voltage of 500 *V*. The armature resistance is 0.04Ω, the series-field resistance is 0.05Ω, and the shunt-field resistance is 250Ω. The voltage drop per brush may be taken as 1.0 *V*. Determine the e.m.f. generated. Also, calculate the number of armature conductors if the speed of the armature is 1000 r.p.m. and the flux per pole is 10 *mWb*.

(4+2 Marks)

(ii) The maximum flux density in the core of a 250/3000-volts, 50 *Hz* single-phase transformer is 80 m*Wb/m*^{2}. If the e.m.f. per turn is 8 volt, determine the area of the core.

(4 marks)