

CS/B.Tech/EE/EEE/Even/Sem-4th/EE-401/2015



## WEST BENGAL UNIVERSITY OF TECHNOLOGY

EE-401

## ELECTRIC MACHINE-I

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.**The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

## GROUP A

## (Multiple Choice Type Questions)

1. Answer any *ten* questions.

10×1 = 10

(i) The magnetic stored-energy density in iron is given by

- (A)  $\frac{1}{2} \phi^2 \mu$       (B)  $\frac{1}{2} B^2 \mu$       (C)  $\frac{1}{2} \frac{B^2}{\mu}$       (D)  $\frac{1}{2} \frac{B}{\mu}$

(ii) The developed electromagnetic force and/or torque in electromechanical energy conversion systems act in such a direction that tends

- (A) to increase the stored energy at constant mmf  
 (B) to decrease the stored energy at constant flux  
 (C) to decrease the co-energy at constant mmf  
 (D) to decrease the stored energy at constant mmf

(iii) D.C. generator works on the principle of

- (A) Fleming's left hand rule      (B) Fleming's right hand rule  
 (C) Lenz's law      (D) none of these

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- (iv) In normal D.C. machines operating at full-load conditions, the most powerful electromagnet is
- (A) Field winding
  - (B) Armature winding
  - (C) Interpole winding
  - (D) Interpole and Compensating windings together
- (v) At a certain speed and flux, the voltage generated by a D.C. generator is 230 volts. If the speed is increased by 20% and the flux is simultaneously reduced by 10%, the voltage will be
- (A) increased by 10%
  - (B) reduced by 20%
  - (C) increased by 8%
  - (D) decreased by 8%
- (vi) In a 4-pole, 25 KW, 200V wave wound D.C. shunt generator the current in each parallel path will be
- (A) 62.5A
  - (B) 125A
  - (C) 31.25A
  - (D) 250A
- (vii) A starting torque at 80 Nm is developed in an induction motor by an auto-transformer starter with a tapping of 30%. If the tapping of auto – transformer is 60%, then the starting torque will be
- (A) 40 Nm
  - (B) 160 Nm
  - (C) 240 Nm
  - (D) 320 Nm
- (viii) Synchronous speed of an induction motor can be increased by
- (A) reducing the mechanical friction
  - (B) increasing the supply voltage
  - (C) increasing number of poles
  - (D) increasing supply frequency
- (ix) An 8- pole wound rotor induction motor operating at 60 Hz supply is driven at 1800 r.p.m. by a prime mover in the opposite direction of the revolving field. The motor current frequency is
- (A) 60 Hz
  - (B) 120 Hz
  - (C) 180 Hz
  - (D) none of these
- (x) The flux in transformer core
- (A) increases with load
  - (B) decreases with load
  - (C) remains constant irrespective of load
  - (D) none of these

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- (xi) A 3-phase transformer has its primary connected in delta and secondary in star. Secondary to primary turns ratio per phase is 5. For a primary voltage of 400V, the secondary voltage would be
- (A) 2000V      (B) 80V      (C) 3464V      (D)  $80\sqrt{3}$  V
- (xii) In which transformer, the tertiary winding is used?
- (A) Star- delta      (B) Delta- delta      (C) Star- star      (D) Delta- star

**GROUP B**  
(Short Answer Type Questions)

Answer any *three* questions.

3×5 = 15

2. State and explain the three basic principles for electromechanical energy conversion.
3. "The D.C. shunt generators are self-protective against accidental short-circuit"- explain.
4. A 6- pole induction motor is fed from 50 Hz supply. If the frequency of rotor emf at full load is 2 Hz, find the full- load speed and slip.
5. Explain the significance of vector groupings of transformers. Mention different vector groupings of 3- phase transformers with their meanings.
6. What is open delta Connection? Explain its utility.

**GROUP C**  
(Long Answer Type Questions)

Answer any *three* questions.

3×15 = 45

7. (a) Based on the principle of conservation of energy, write an energy balance equation for a motor. Also write briefly about the various energy terms involved. 9
- (b) Two magnetic surfaces separated by a distance  $g$  have flux density of 1.6T in between them. This value is usually the saturation level for ferro-magnetic materials. Find the force between these two surfaces for area  $A = 1\text{m}^2$ . 4
- (c) A coil of 1000 turns on a core would create a flux of 2 mWb when carrying 2

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a current 1 A. Calculate the energy stored in the magnetic field.

8. (a) Explain the armature reaction of a D.C. machine. What is effect of armature reaction? How to minimize the effect of armature reaction? 9
- (b) A 6-pole, 148A D.C. shunt generator has 480 conductors and is wave connected. Its field current is 2A. Find the demagnetizing and cross-magnetizing ampere-turns per pole at full load, if 6
  - (i) Brushes are at GNA. (ii) Brushes are shifted from GNA by  $5^\circ$  electrical
  - (iii) Brushes are shifted from GNA by  $5^\circ$  mechanical.
9. (a) Draw and explain the Torque-slip or Torque-speed curve of an 3-phase induction motor. In which portion of the curve the motor shall be operated and why? 7
- (b) How the rotation of 3-phase induction motor can be reversed? 1
- (c) An induction motor can never run at synchronous speed-Explain. 2
- (d) A 3-phase induction motor has starting torque of 100% and a maximum torque of 200% of full-load torque. Find slip at maximum torque. 5
- 10.(a) Mention the conditions to be fulfilled for parallel operation of two 3-phase transformers. 6
- (b) How Group-3 and Group-4 transformers can be made to run in parallel? 2
- (c) A 500 KVA transformer with 1.5% resistive and 5% reactive drops is connected in parallel with a 1000 KVA transformer with 1% resistive and 4% reactive drops. The secondary voltage of each transformer is 400V on load. Determine how they share a load of 500 KVA at a p.f. of 0.8 lagging. 7
11. Write short notes on any *three* of the following: 3×5
  - (a) Regenerative braking of D.C. series motors.
  - (b) Star- delta starter of induction motor.
  - (c) Function of brush and commutator of D.C. Machines.
  - (d) Current Transformer.
  - (e) Grounding Transformer.