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Total Number of Pages: 02

B.TECH
PME5H001

5th Semester Regular Examination 2017-18

ENERGY CONVERSION TECHNIQUES

BRANCH: MECH

Time: 3 Hours

Max Marks: 100

Q.CODE: B491

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 Answer the following questions:

(2 x 10)

- a) The no load terminal voltage of a dc shunt generator is 220V. If the direction of rotation is reversed the voltage to which it build up is:
(A) 220 V (B) -220 V (C) 0 V (D) 22 V
- b) The slip of an induction motor normally does not depend on
(A) rotor speed (B) synchronous speed
(C) shaft torque (D) core-loss component
- c) A 4 point starter is used to start and control the speed of a
(A) dc shunt motor with armature resistance control
(B) dc shunt motor with field weakening control
(C) dc series motor (D) dc compound motor
- d) A field excitation of 20 A in a certain alternator results in an armature current of 400 A in short circuit and a terminal voltage of 3464 V on open circuit. The magnitude of the internal voltage drop within the machine at a load current of 200 A is
(A) 1 V (B) 10 V (C) 100 V (D) 1000 V
- e) The maximum power developed in the synchronous motor will depend on
(A) rotor excitation only
(B) maximum value of coupling angle
(C) supply voltage only
(D) Rotor excitation supply voltage and maximum value of coupling angle.
- f) The type of machine having highest no load current is
(A) Transformer (B) DC shunt motor
(C) 3 phase Synchronous motor (D) 3 phase Induction motor
- g) A single phase transformer has a maximum efficiency of 90% at full load and unity power factor. Efficiency at half load at the same power factor is
(A) 86.7% (B) 88.26% (C) 88.9% (D) 87.8%
- h) A 3 phase, 50Hz, 4 pole synchronous machine has a rotating armature. What will be the speed of rotating magnetic field w.r.t the stator?
(A) 1500rpm (B) -1500rpm (C) 0rpm (D) 3000 rpm
- i) It is desired to measure parameters of 230 V/115 V, 2 kVA, single-phase transformer. The following wattmeters are available in laboratory:
W1 : 250 V, 10 A, Low Power Factor W2 : 250 V, 5 A, Low Power Factor

W3 : 150 V, 10 A, High Power Factor W4 : 150 V, 5 A, High Power Factor

The Wattmeters used in open circuit test and short circuit test of the transformer will respectively be

(A) W1 and W2 (B) W2 and W4 (C) W1 and W4 (D) W2 and W3

- j) The direction of rotation of a 3-phase induction motor is clockwise when it is supplied with 3-phase sinusoidal voltage having phase sequence A-B-C. For counter clockwise rotation of the motor, the phase sequence of the power supply should be
(A) B-C-A (B) C-A-B (C) A-C-B (D) B-C-A or C-A-B

Q2 Answer the following questions:

(2 x 10)

- a) How does a dc motor adjust itself to match the mechanical load?
- b) A single phase transformer has a hysteresis and eddy current loss of 150W and 100W respectively when supplied from 250V, 50Hz. What will be the corresponding losses when supplied from 250V, 30Hz?
- c) Four terminals of a dc shunt machine are available, but these are unmarked. How would you identify field and armature terminals?
- d) Why the air gap length in a synchronous machine is higher compared to an induction machine?
- e) What is the condition for maximum efficiency in a DC Motor?
- f) Why are the transformer rated in kVA and not in kW?
- g) Explain why an induction motor at no load operates at a very low power factor?
- h) Why DC Series motor is used to start heavy loads?
- i) Differentiate between a single 3-phase transformer and a transformer bank.
- j) What is the load angle for which a synchronous machine delivers maximum power?

Part – B (Answer any four questions)

- Q3 a)** A 250V, 20Kw shunt motor running at 1500 rpm has a maximum efficiency of 85%, when delivering 80% of its rated output. The shunt field resistance is 125Ω. Determine efficiency and speed when it draws 100A from mains. **(10)**

- b)** Derive the EMF equation of DC generator by BLV concept. **(5)**

- Q4 a)** Explain the speed vs. Torque and Speed vs. Armature Current characteristics of a Dc shunt and series Motor. **(10)**

- b)** Explain the working of a 3-point starter with a neat diagram. **(5)**

- Q5 a)** A 10 KVA, 2500/250 V, single-phase, transformer gave the following test results: **(10)**

Open-circuit test: 250 V, 0.8 A, 50 W

Short-circuit test: 60 V, 3 A, 45 W

- (i) Calculate the efficiency at ¼ of full load at 0.8 power factor.
- (ii) Calculate the load (KVA output) at which maximum efficiency occurs and the value of maximum efficiency at upf?

- b)** A 600kVA, single phase transformer has an efficiency of 92% both at full load and half load at unity power factor. Determine its efficiency at **(5)**

60% full load at 0.8 p.f lag ?

Q6 a) Explain different methods available for controlling speed of 3 phase induction motor? **(10)**

b) A 3-phase induction motor having a 6pole, star connected stator runs from 240V, 50HZ supply .The rotor resistance and standstill reactance are 0.12Ω and 0.85Ω per phase .The ratio of stator to rotor turns is 1.8 and full load slip is 4%. Calculate the developed torque at full load and maximum torque. Also calculate the slip at which maximum torque occurs. **(5)**

Q7 a) Explain full dark lamp and 1-bright 2-dark lamp method of synchronization. **(10)**

b) Derive the power angle ($P-\delta$) equation of a cylindrical rotor alternator?Also explain its characteristic? **(5)**

Q8 a) Explain various method of starting a three-phase Induction motor. **(10)**

b) A 6 pole alternator has an armature of 90 slots and 8 conductors per slot and rotates at 1000rpm ,the flux per pole is 50 m Wb ,Calculate the e.m.f generated if the winding factor is 0.96 and all conductors are in series in each phase ? **(5)**

Q9 Write short notes on any three (5X3)

a) Voltage buildup of DC shunt generator.

b) O.C. and S.C. test of single-phase transformer.

c) Double field revolving theory.

d) Speed control of DC shunt motor by flux control method.