

**BTECH**  
**(SEM IV) THEORY EXAMINATION 2018-19**  
**ELECTROMECHANICAL ENERGY CONVERSION-II**

Time: 3 Hours

Total Marks:100

Notes:

1. The question paper contains three sections- A, B & C.
2. Read the instructions carefully in each section

**SECTION-A**

**1. Attempt all the parts:****[10X2=20]**

- a) What is slip? Why three phase induction motor cannot run at synchronous speed?
- b) Why lightly loaded induction motor has low power factor?
- c) What do you understand by cogging?
- d) Which motor can be used for power factor improvement?
- e) How many types of rotor construction are there in synchronous machine? What are their applications?
- f) What are the important applications of stepper motor?
- g) Which motor can be used on ac as well dc? What are its applications?
- h) Draw the torque slip characteristics for 3-phase induction machine in motoring and generating mode.
- i) Draw V curves & inverted V curves for synchronous motor.
- j) What are the factors on which the frequency of voltage generated in an alternator depends?

**SECTION B**

**2. Attempt any FIVE questions of the following:****[5X10=50]**

- a) A three phase, 16 pole synchronous generator has a resultant air gap flux density of 0.06 wb per pole. The flux is distributed sinusoidally over the pole. The stator has two slots per pole per phase and 4 conductors per slot are accommodated in two layers. The coil span is 150 degrees electrical. Calculate the phase and line induced voltages when machine runs at 375 rpm.
- b) The following table gives the open circuit and full load zero p.f. saturation characteristics data for 40 kVA, 400 V, 3 phase 50 hz, star connected alternator

Exciting current in A	6	8	12	18	24	28
Open circuit line volts	282	-	400	435	459	474
Zero p.f. line V	-	0	-	-	-	400

Find the values of armature reaction in equivalent field current ) and armature leakage reactance. Also determine the voltage regulation at 0.8 lagging p.f.. Neglect armature resistance.

- c) Draw the phasor diagram of three phase alternator under
  - (i) lagging p.f. (ii) unity p.f.(iii) leading p.f
- d) Explain following:
  - (i) parallel operation of alternator
  - (ii) Hunting

- e) From the phasor diagram of the salient pole synchronous machine, show that

$$\tan \delta = \frac{I_a X_q \cos \phi - I_a R_a \sin \phi}{V_t - I_a X_q \sin \phi - I_a R_a \cos \phi}$$

where the symbols having their usual meaning

- f) Explain the effect of varying of excitation of a synchronous generator connected to infinite busbar on the power factor, armature current and load angle.
- g) A salient pole synchronous motor has  $X_d=0.85$  p.u. &  $X_q=0.55$  p.u. It is connected to busbar of 1.0 pu voltage, while its excitation is adjusted to 1.2 pu. Calculate the maximum power output, the motor can supply without loss of synchronism. Compute the minimum pu. Excitation that is necessary for the machine to stay in synchronism.

### SECTION-C

#### 3. Attempt any two of the following:

[2X15=30]

- a) Explain double revolving field theory for the single phase induction motor.  
 220 V, 1 phase induction motor has following test results:  
 No load test :  $V=220$  V,  $I=6$  A,  $P=350$  W  
 Locked rotor test :  $V=125$  V,  $I=15$  A,  $P=580$  W  
 Stator resistance : 1.2 ohm with direct current  
 Estimate efficiency and p.f. at 0.05 pu slip.
- b) A 6 pole , 50 hz 3 phase slip ring induction motor has a resistance and reactance of 0.5 ohm and 5 ohm per phase respectively. Calculate (i) At what speed the torque is maximum(ii) the ratio of maximum torque/ starting torque. What must be the external resistance per phase so that the starting torque is half of the maximum torque.
- c) Write short note:  
 (i) Deep bar rotor  
 (ii) Crawling in induction motor  
 (iii) Stepper Motor  
 (iv) Slip power recovery scheme
- d) For a 4 pole , 3 phase, 50 hz induction motor has rotor resistance of 0.2 ohm per phase and rotor standstill reactance of 1 ohm per phase. On full load it is running with a slip of 4%. Calculate the extra resistance required in the rotor circuit per phase to reduce the speed to 1260 rpm, on the same load condition.