

**II B.Tech II Semester Supplementary Examinations, Apr/May 2008**  
**ELECTRICAL TECHNOLOGY**  
 ( Common to Electronics & Communication Engineering, Computer Science  
 & Engineering, Information Technology, Computer Science & Systems  
 Engineering, Electronics & Telematics, Electronics & Computer Engineering  
 and Instrumentation & Control Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

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1. (a) Explain how a.c. voltage generated is converted to D.C. voltage in a generator?  
 (b) What is the main purpose of laminating the armature core of a D.C. Generator.  
 (c) A 4-pole, long shunt, lap wound generator supplies 25kw at a terminal voltage of 500 V. The armature resistance is  $0.03\Omega$ , series field resistance is  $0.04\Omega$  and shunt field resistance is  $200\Omega$ . The brush drop may be taken as 1 V. Determine the e m f generated. [5+3+8]
  
2. (a) What is the significance of the back e.m.f. of a D.C. Motor?  
 (b) Deduce the condition for maximum power for a D.C. Motor?  
 (c) A 220V shunt motor with an armature resistance of  $0.5\Omega$  is excited to give constant main field. At full load the motor runs at 500 rpm and takes an armature current of 30A. If a resistance of  $1.0\Omega$  is placed in the armature circuit, find the speed at
  - i. full-load torque
  - ii. double full-load torque. [4+4+8]
  
3. (a) Explain the principle of operation of a single-phase transformer when it supplies lagging power factor load. Draw the phasor diagram under this condition.  
 (b) A 4 kVA, 200 / 400 V, 50 Hz, transformer gave the following the test figures:

No Load:	Low voltage data:	200 V	0.7 A	60 W
Short Circuit:	High voltage data:	9 V	6A	21.6 W

Calculate the magnetizing current and component corresponding to iron loss at normal voltage and frequency. Find the efficiency on full load at unity power factor. Also determine the regulation at half-full load 0.707 leading power factor. [8+8]

4. (a) What are the transformer tests? Explain.  
 (b) Calculate the efficiencies at half-full and  $1\frac{1}{4}$  load of a 100kVA transformer for power factors of
  - i. unity;
  - ii. 0.8, the copper loss is 1000W at full load = iron loss. [10+6]

5. (a) Explain various power stages of a 3-phase induction motor.
- (b) A 3-phase induction motor with  $r_2 / x_2 = 0.5$ , has a starting torque of 25.0 Nm. For negligible stator impedance and no-load current, determine the starting torque in case the rotor-circuit resistance per phase is
- i. doubled
  - ii. halved. [6+10]
6. (a) Derive e.m.f equation for an alternator and explain distribution factor and pitch factor used in e.m.f. Equation.
- (b) Write the expression showing the relationship between speed frequency and no. of poles of a synchronous machine. The speed of rotation of the turbine driving an alternator is 166.7 r.p.m. What should be the no. of poles of the alternator if it is to generate voltage 50HZ. [10+6]
7. (a) Explain the principle of operation of synchronous motors.
- (b) A 3-phase alternator is rated at 5 KVA, 110V, 26.3A, 50 Hz and 1200 r.p.m. The stator resistance between terminals as measured with dc is 0.2 ohm. With no load and rated speed the stator line voltage is 160V for a field current of 4A. At rated speed, the short circuit stator current per terminal is 50A for a field current of 4A. compute voltage regulation of alternator at 0.8 p.f. Lagging. Using synchronous impedance method. [8+8]
8. (a) Draw a diagram showing the construction of a stepper motor and discuss its operation.
- (b) Discuss the various applications of stepper motor. [10+6]

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2. (a) From the first principles, derive an equation for torque developed in a D.C. Motor.  
 (b) A 20kw, 250V d.c. shunt generator has armature and field resistances of  $0.04\Omega$  and  $200\Omega$  respectively. Determine the total armature power developed when working.
  - i. as generator delivering 20kw output and
  - ii. as a motor taking 20kw input. [8+8]
  
3. (a) Explain the principle of operation of transformer. Derive its e. m. f. equation.  
 (b) A 1-phase transformer has 180 turns respectively in its secondary and primary windings. The respective resistances are  $0.233\Omega$  and  $0.067\Omega$ . Calculate the equivalent resistance of
  - i. the primary in terms of the secondary winding,
  - ii. the secondary in terms of the primary winding, and
  - iii. the total resistance of the transformer in terms of the primary. [8+8]
  
4. Write short notes on:
  - (a) OC and SC tests on transformers.
  - (b) Losses in transformers. [10+6]
  
5. (a) Sketch torque-speed characteristics of an induction motor working at rated voltage and frequency, deriving necessary expressions.  
 (b) A 3-phase, 50 Hz, 400 V, wound-rotor induction motor runs at 960 r.p.m. at full-load. The rotor resistance and standstill reactance per phase are  $0.2\Omega$  and  $1\Omega$  respectively. If a resistance of  $1.8\Omega$  is added to each phase of

the rotor at standstill, what would be the ratio of starting torque with full voltage and the added resistance to the full-load torque under normal running conditions? [8+8]

6. (a) Define voltage regulation of an alternator. Explain synchronous impedance method of determining regulation of an alternator.  
(b) Calculate the voltage induced per phase in a 3phase 50 Hz, alternator having a flux per pole of 0.1515 wb. The no. of conductors in series are 360. Assume full pitch coil with a distribution factor of 0.96. [8+8]
7. (a) Explain why a synchronous motor doesn't have self-starting torque. Explain one method of starting a synchronous motor.  
(b) A 3phase, 3300v, star connected synchronous motor has a synchronous reactance of 5ohm per phase. The input to the motor is 1000kw at a normal voltage and the induced line e.m.f is 4000v. Calculate the line current. Neglect armature resistance. [8+8]
8. (a) Give the description of A.C tachometer and mention its applications.  
(b) Write a short note on shaded pole type servo-motor. [8+8]

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1. (a) List out applications of D.C. generators and motors.  
(b) A 400V shunt generator has full load current of 200A, its armature resistance is  $0.06\Omega$ , field resistance  $100\Omega$ ; the stray losses are 2,000W. Find the horse power of its prime-mover when it is delivering full load and find the load for which the efficiency of the generator is maximum. [8+8]
2. (a) Explain with a neat sketch the principle of operation of a D.C. Motor.  
(b) A 4-pole series motor has 944 wave-connected armature conductors. At a certain load the flux per pole is 34.6 mWb and the total mechanical torque developed is 209 Nm. Calculate the line current taken by the motor and the speed at which it will run with an applied voltage of 500V. Total armature resistance is  $3\Omega$ . [8+8]
3. (a) Explain the principle of operation of transformer. Derive its e. m. f. equation.  
(b) A 1-phase transformer has 180 turns respectively in its secondary and primary windings. The respective resistances are  $0.233\Omega$  and  $0.067\Omega$ . Calculate the equivalent resistance of
  - i. the primary in terms of the secondary winding,
  - ii. the secondary in terms of the primary winding, and
  - iii. the total resistance of the transformer in terms of the primary. [8+8]
4. (a) Write short notes on open circuit and short circuit tests on 1-phase transformers.  
(b) Calculate the effective resistance and leakage reactance of a transformer, in terms of primary the following data on test with the secondary terminals, short-circuited: Applied voltage, 60V; current, 100A; Power input, 1.2kW. [10+6]
5. (a) Explain the Autotransformer starters used in induction motors. What are its advantages? [6+2]  
(b) A 200 kW, 3300 V, 6-pole, 50 Hz star-connected slip-ring induction motor has a star connected rotor. Stator to rotor turns ratio is 3.2. Rotor resistance and leakage reactance are  $0.1\Omega$  and  $1\Omega$  respectively. Neglect stator impedance. Find

- i. current and torque at starting on rated voltage and with slip rings short circuited and
- ii. the external resistance required to reduce the starting current to 50 A with across-the-line starting.

Compute also the starting torque under these conditions. [8]

6. (a) Explain the synchronous impedance method of computing the voltage regulation.
- (b) A 3 phase, 12 pole, star connected alternator has 180 slots with 10 conductors per slot and the conductors of each phase are connected in series. The coil span is 144 degrees (electrical). Determine the phase and line value of e.m.f. If the machine runs at 1600 r.p.m and the flux per pole is 0.06 Weber distributed sinusoidally over the pole. [8+8]
7. (a) Explain the principle of operation of synchronous motors.
- (b) A 3-phase alternator is rated at 5 KVA, 110V, 26.3A, 50 Hz and 1200 r.p.m. The stator resistance between terminals as measured with dc is 0.2 ohm. With no load and rated speed the stator line voltage is 160V for a field current of 4A. At rated speed, the short circuit stator current per terminal is 50A for a field current of 4A. compute voltage regulation of alternator at 0.8 p.f. Lagging. Using synchronous impedance method. [8+8]
8. (a) Discuss the function of an a.c.tacho.meter. Explain its construction and operations.
- (b) What are the applications of stepper motor and synchros? [10+6]

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1. (a) Compare the operation of a D.C. Generator and Motor, and mention one application of each machine.  
(b) A d.c. shunt machine connected to 250V mains has an armature resistance (including brushes) of  $0.1\Omega$  and the resistance of the field circuit is  $125\Omega$ . Find the ratio of the speed as a generator to the speed as a motor, the line current in each case being 80A. [8+8]
2. (a) From the first principles, derive an equation for torque developed in a D.C. Motor.  
(b) A 20kw, 250V d.c. shunt generator has armature and field resistances of  $0.04\Omega$  and  $200\Omega$  respectively. Determine the total armature power developed when working.
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  - i. the primary in terms of the secondary winding,
  - ii. the secondary in terms of the primary winding, and
  - iii. the total resistance of the transformer in terms of the primary. [8+8]
4. (a) With neat circuit diagrams, explain the procedure for conducting OC & SC tests on a given single-phase transformer to predetermine its regulation & efficiency.  
(b) A 100KVA, 1000V / 10000V, 50Hz, single phase transformer has an iron loss of 1200 W, find the maximum efficiency at 0.8 power factor lagging if the copper loss is 500 W with 6A in high voltage winding. Also calculate the corresponding regulation if the equivalent leakage reactance referred to HV is 10 ohms. [10+6]
5. (a) Explain the Autotransformer starters used in induction motors. What are its advantages? [6+2]

- (b) A 200 kW, 3300 V, 6-pole, 50 Hz star-connected slip-ring induction motor has a star connected rotor. Stator to rotor turns ratio is 3.2. Rotor resistance and leakage reactance are  $0.1\Omega$  and  $1\Omega$  respectively. Neglect stator impedance. Find
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