II B.Tech. II Semester Regular Examinations, April/May -2005
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) Mention the reasons for compounding D.C. Generator. Neatly sketch and explain the external characteristics of a D.C. Compound Generator.
   (b) A short shunt compound generator delivers a load current of 30A at 220V and has armature, series field and shunt field resistances of $0.05\Omega, 0.03\Omega$ *and* 200Ω respectively. Calculate the induced emf and the armature current. Allow 1.0V per brush for contact drop.

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 0.5Ω 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 1.0Ω is placed in the armature circuit, find the speed at
      i. full-load torque
      ii. double full-load torque.

3. Discuss the constructional details of single-phase transformer and hence obtain the expression for induced e. m. f. of transformer.

4. (a) Develop the equivalent circuit of a single-phase transformer.
   (b) A 200 kVA, 1- phase, 3300 / 400 V transformer gave the following results in the short circuit test with 200 V applied to the primary and secondary short circuited, the primary current was full load value and the input power was 1650 W. Calculate the secondary potential difference and the % of regulation when the full load current was passing at a 0.707 p. f. lagging with normal primary voltage.

5. (a) With usual notation deduce the expression for starting torque of a 3-phase induction motor.
   (b) The rotor of a 3-phase induction motor has 0.04Ω resistance per phase and 0.2Ω standstill reactance per phase. What external resistance is required in the rotor circuit in order to get half of the maximum torque at starting? Neglect stator impedance. By what percentage will this external resistance change the current and pf at starting?

6. (a) Draw the open circuit and short circuit characteristics of a synchronous generator. Explain the shape of the characteristics.

   (b) Determine the voltage regulation of a 200V per phase alternator at 0.8p.f lag giving a current of 100A is produced on short circuit by a field excitation of 2.5A.An e.m.f of 500V is produced on open circuit by the same excitation. The armature resistance is 0.8 ohm.

7. (a) A 500V, 50Hz single-phase synchronous motor takes 50A current at a power factor of 0.8 lagging. The motor has a sychronous reactance of 20ohm and negligible resistance, the armature has 120 full pitch coils in series, with a distribution factor of 0.95. Assuming a sinusoidal variation of flux in the air gap. Calculate the flux per pole.

   (b) Draw the phasor diagram of a synchronous motor.

8. (a) Give the description of A.C tachometer and mention its applications.

   (b) Write a short note on shaded pole type servo-motor.

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Code No: RR220402 **Set No.2**

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1. (a) Explain the constructional features of a D.C. Machine with the help of a neat sketch.
   (b) Name the main parts of a D.C. Machine and state the materials of which each part is made.
   (c) Explain different methods of excitation of D.C. Generators with suitable diagrams.

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 3Ω.

3. (a) Explain the operation of transformer on load.
   (b) A single-phase transformer with a ratio of 440 / 110 V takes a no-load current of 5 A at 0.2 power factor lagging. If the secondary supplies a current of 120 A at a power factor of 0.8 lagging, estimate the current taken by the primary.

4. Write short notes on:
   (a) OC and SC tests on transformers.
   (b) Losses in transformers.

5. (a) Sketch the torque-speed curve of an induction motor and indicate how this will change when the rotor resistance is doubled keeping stator voltage and frequency unchanged.
   (b) A 3-phase star-connected, 440 V, 50 Hz, 4-pole induction motor has the following constants in ohms per phase referred to stator side $r_1 = 0.294$, $x_1 = 0.503$, $r_2 = 0.144$, $x_2 = 0.209$. The stator core losses are negligible. Total friction and other losses (assumed constant) = 1400 W. Find the power output in kW and the rated output in Nm if the motor is being operated at rated voltage and frequency with 5 percent slip.

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.

7. (a) Explain why a synchronous motor doesnt 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. (a) Give the description of A.C tachometer and mention its applications.

   (b) Write a short note on shaded pole type servo-motor.

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   (b) Name the main parts of a D.C. Machine and state the materials of which each part is made.
   (c) Explain different methods of excitation of D.C. Generators with suitable diagrams.

2. (a) Derive an expressions for torque of a d.c. motor.
   (b) Explain how the torque of a D.C. shunt and D.C. series motor varies with the speed of the motor.
   (c) The armature resistance of a 220 V d.c. shunt motor is 0.4Ω and it takes a no-load armature current of 2 A and runs at 1,350 rpm. Find the speed when taking an armature current of 50 A if armature weakens the flux by 2%.

3. (a) Draw the phasor diagram of a transformer on
      i. no load,
      ii. full load with inductive load and explain.
   (b) A 1-phase transformer is supplied 6000 V. The terminal voltage on the secondary sidewhen loaded at power factor 0.8 is 254 V. The equivalent resistance and reactance drops are 1 and 5%. Find the turn ratio.

4. (a) 'Efficiency and regulation can be predicted from OC and SC tests'. Justify.
   (b) A 5 kVA, 1-phase transformer rated at 50 Hz, 200 / 400 volts gave the following test data: S.C. Test: 9 Volts, 6 Amps, and 21.6 Watts (on HV side); O. C. Test: 200 Volts, 0.7 Amps, 60 Watts (on LV side); For the above transformer: Draw the equivalent circuit and insert the various parameters on it referred to
      i. primary and
      ii. secondary.

5. (a) With usual notation deduce the expression for starting torque of a 3-phase induction motor.

(b) The rotor of a 3-phase induction motor has 0.04Ω resistance per phase and 0.2Ω standstill reactance per phase. What external resistance is required in the rotor circuit in order to get half of the maximum torque at starting? Neglect stator impedance. By what percentage will this external resistance change the current and pf at starting?

6. (a) Draw the open circuit and short circuit characteristics of a synchronous generator. Explain the shape of the characteristics.

   (b) Determine the voltage regulation of a 200V per phase alternator at 0.8p.f lag giving a current of 100A is produced on short circuit by a field excitation of 2.5A.An e.m.f of 500V is produced on open circuit by the same excitation. The armature resistance is 0.8 ohm.

7. (a) Explain why a synchronous motor doesnt 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. (a) Draw a diagram showing the construction of a stepper motor and discuss its operation.

   (b) Discuss the various applications of stepper motor.

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1. (a) Enumerate the various losses and their remedy to minimize them in a D.C. Machine.
   (b) How do hysteresis, eddy current, friction and windage losses depend upon the speed of a D.C. Machine? Explain.
   (c) A 200V D.C. Shunt machine has armature and field resistances 0.2Ω and 200Ω respectively. The line current is 40A.

   Find
   i. output as generator
   ii. input as motor
   iii. power developed in armature and
   iv. copper losses in both the cases.

2. (a) With a neat sketch, explain the working of a 3-point starter for d.c. shunt motor
   (b) A 6-pole, 250V series motor is wave-connected. There are 240 slots and each slot has 4 conductors. The flux per pole is $1.75X10^{-2}Wb$ when the motor is taking 80A. The filed resistance is 0.05Ω, the armature resistance is 0.1Ω and the iron and frictional loss is 0.1kw. Calculate
   i. Speed
   ii. bhp and
   iii. shaft torque.

3. Discuss the constructional details of single-phase transformer and hence obtain the expression for induced e. m. f. of transformer.

4. (a) Derive the condition for maximum efficiency of a transformer.
   (b) The parameters of the equivalent circuit for a 1-phase transformer are $R_0 = 400\Omega, X_0 = 231\Omega, R_t = 0.16\Omega and X_t = 0.7\Omega$. The input voltage is 200 V, and load $5.96 + j4.44\Omega$. (All values are referred to primary.) The ratio of secondary to primary turns is 10. Find the secondary terminal voltage; the primary current; and the efficiency.

5. (a) Explain the principle of rotating magnetic field and hence prove that it is of constant magnitude and rotates at synchronous speed.

   (b) A 3-phase, 4 pole 50 Hz induction motor has a full-load speed of 1440 r.p.m. For this motor, calculate the following

      i. full-load slip and rotor frequency

      ii. speed of stator field with respect to

         A. stator structure and

         B. rotor structure and

      iii. speed of rotor field with respect to

         A. rotor structure

         B. stator structure and

         C. stator field.

6. (a) Draw a neat sketch showing the various parts of a synchronous machine and explain each part briefly.

   (b) A 3ph, 50 Hz, 20 poles Salient pole alternator with star connected stator winding has 180 slots on the stator. Each slot consists of 8 conductors. The flux per pole is 25mwb and is sinusoidally distributed. The coils are full pitch.

   Calculate

      i. the speed

      ii. the generated e.m.f per phase and

      iii. the line e.m.f.

7. (a) Compare $3-\phi$ induction motor with $3-\phi$ synchronous motor if any four aspects.

   (b) The input to an 1100 V, 3 phase star connected synchronous motor is 60 A. The effective resistance and synchronous reactance per phase is 1 ohm and 30 ohm respectively. Find the power supplied to the motor and the induced e.m.f for a power factor of 0.95 leading.

8. (a) Discuss the differences between capacitor start. Capacitor run and permanent split capacitor motors.

   (b) A small motor has an output torque of 0.25 N.m and a speed of 100 rad/sec. If the input current is 0.6 A at 230 V and 0.6 lagging p.f find

      i. output power in watts

      ii. efficiency.

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