Code No: R21025 **R10** SET - 1

II B. Tech I Semester, Regular Examinations, Nov – 2012
ELECTRICAL MACHINES -1
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Explain briefly about singly-excited and doubly-excited systems with suitable examples.
   b) Explain the mechanical energy and work done in singly excited system when actual displacement occurs?

2. a) Explain the function of commutator in a D.C. generator.
   b) Design a 4-pole, simplex lap winding suitable for an armature containing 20 slots. Assume single turn coils with 2 conductors per slot.

3. a) What is the purpose of using an interpole in a dc machine? Why an interpole winding is connected in series with armature?
   b) A 500 V, wave-wound, 750 rpm shunt generator supplies a load current of 195 A. The armature has 720 conductors and shunt field resistance is 100 Ω. Find the demagnetizing ampere-turns/pole if the brushes are advanced through 3 segments at this load. Also calculate the extra shunt field turns required to neutralize this demagnetization.

4. a) It is found that the voltage of a dc shunt generator does not build up. Explain the various possible causes of this failure.
   b) A series generator having a combined armature and field resistance of 0.4 Ω is running at 1,000 r.p.m. and delivering 5.5 kW at a terminal voltage of 110V. If the speed is raised to 1500 r.p.m. and load adjusted to 10kW, Find the new current and terminal voltage. Assume the machine is working on the straight line portion of the magnetization characteristic.

5. a) What is the necessity for parallel operation of generators? Why cross connection of field windings is done in compound generators?
   b) Two shunt generators are running in parallel. The no load voltage of each generator is 120 V. Generator 1 is rated at 250 kW and its full-load voltage is 115 V. Generator 2 is rated at 200 kW at 112 V. If the load supplied is 3600 A, calculate: (i) bus bar voltage (ii) output current of each generator.
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6. a) Explain speed-current, speed-torque and torque-current characteristics of a series motor.
   b) A 400 V dc shunt motor takes 5 A at no-load. Its armature resistance (including brushes) is 0.5 Ω and shunt field resistance is 200 Ω. Estimate the kW output and efficiency when the motor takes 50 A on full load.

7. a) Explain field flux control method for speed control of a dc machine. Also discuss its limitations.
   b) A dc series motor drives a fan at 800 rpm and takes 20 A when fed from rated voltage of 230 V. The motor resistance is 0.4 Ω. The motor speed is to be raised to 1000 rpm by voltage control. Find the voltage and current in case magnetic circuit is (i) saturated and (ii) unsaturated.

8. a) Explain how rotational losses can be estimated using retardation test.
   b) The Hopkinson's test on two dc shunt machines gave the following results for full load. Line voltage 250 V, line current excluding field current is 50 A, motor armature current is 38 A, motor field current is 4.2 A and generator field current is 5 A. Armature resistance of each machine is 0.002 Ω. Calculate the efficiency of each machine.

Code No: R21025 **R10** SET - 2

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Time: 3 hours Max. Marks: 75

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1. a) What is the significance of energy and co-energy in energy conversion system.
   b) A solenoid relay is operated from a 110 V dc supply and the 5000-turn coil resistance is 5.5 kΩ. The core diameter of the relay is 20 mm and the gap length is 1.5 mm, the armature being stationary. The gap faces may be taken as parallel and the permeability of the ferromagnetic parts are very high. Find (i) the gap flux density (ii) the coil inductance and (iii) the pull on the armature.

2. a) Draw neat diagram of a 4-pole dc machine. Label all its parts and mention the material used for each part.
   b) A long-shunt compound generator delivers a load current of 50 A at 500 V, and the resistances of armature, series field and shunt fields are 0.05 Ω, 0.03 Ω and 250 Ω respectively. Calculate the generated emf and the armature current. Allow 1.0 V per brush for contact drop.

3. a) What is meant by armature reaction? Show that the effect of armature mmf on the main field is entirely cross-magnetizing.
   b) A compensated generator has an interpole air gap of 0.011 m and a flux density in the interpole air gap of 0.4 T. The ratio of pole arc to pole pitch is 0.66. If armature ampere-turns per pole are 16500, determine the ampere turns per pole for the compensating winding and for the interpole winding.

4. a) Explain the nature of magnetization, external and internal characteristics of a dc shunt generator. Why does the external characteristic of this generator turn back as the generator is overloaded?
   b) The following data pertain to the magnetization curve of a dc shunt generator at 800 r.p.m.

I_f in Amps	0	0.2	0.4	0.65	1.02	1.75	3.15	5.00
E_G in Volts	10	40	80	120	160	200	240	260

   Determine i) critical field resistance at 800 and 900 rpm
   ii) If the field winding resistance is 55 Ω, find the range of field rheostat to vary the voltage from 200 to 250 V, on open circuit at a speed of 800 rpm.
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5. a) Enumerate the reasons for paralleling dc generators. What important conditions must be fulfilled before a shunt generator is connected in parallel with another?
   b) Two 220 V generators operate in parallel. One machine has terminal voltage of 260 V on no-load and 220 V when supplying 30 A. The second machine has a voltage of 270 V on no-load and 220 V when supplying 45 A. Calculate:
   (i) the output voltage (ii) current and (iii) output in kW of each machine when total current is 65 A. Assume the external characteristics to be rectilinear.

6. a) Prove that in a dc generator, generated emf and current in a conductor are in the same direction, whereas in a dc motor, generated emf opposes the flow of current in a conductor.
   b) A 60 kW, 250 V shunt motor takes 16 A when running light at 1440 rpm. The resistance of the armature and field are 0.2 Ω and 125 Ω respectively when hot. (i) Estimate the efficiency of the motor when taking 152 A. (ii) Also estimate the efficiency if working as a generator and delivering a load current of 152 A at 250 V.

7. a) Explain the necessity of a starter for a dc motor? Also explain the operation of a four point starter.
   b) A dc shunt motor is operated from 300 V mains. Its no-load speed is 1200 rpm. When fully loaded, it delivers a torque of 400 N-m and its speed drops to 1,100 rpm. Find its speed and power output when delivering the same torque if operated with an armature voltage of 600 V. Excitation is assumed to be unchanged.

8. a) Describe Swinburne's test with the help of a neat diagram to find out the efficiency of a dc machine.
   b) A field test on two similar series machines gave the following data:
   Motor: armature current = 60 A, voltage across armature = 500 V, voltage across field = 40V.
   Generator: terminal voltage = 450 V, output current = 46 A, voltage across field = 40 V.
   Armature resistance (including brushes) of each machine is 0.25 Ω. Calculate efficiency of both the machines.

Code No: R21025 **R10** SET - 3

II B. Tech I Semester, Regular Examinations, Nov – 2012
ELECTRICAL MACHINES -1
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

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1. a) Explain briefly an electromechanical energy conversion device with the help of a block diagram.
   b) Derive expressions of field energy and co-energy in a singly-excited electromechanical unit.

2. a) Why is a commutator and brush arrangement necessary for operation of a dc machine?
   b) A six pole lap wound dc armature has 70 slots with 20 conductors / slot. The ratio of pole arc to pole pitch is 0.68. The diameter of bore of the pole shoe is 0.46 m. The length of the pole shoe is 0.3 m. If the air gap flux density is 0.3 Wb/m^2 and the e.m.f induced in the armature is 500 V, find the speed at which it runs.

3. a) What is reactance voltage? How is it neutralized in a DC machine?
   b) A 2000 kW, 400 V, 14-pole DC machine has a lap wound armature with 1100 conductors. The pole arc to pole-pitch ratio is 0.7. Compute the number of pole-face conductors of the compensating winding in each pole, so as to obtain uniform air-gap flux density under the pole faces.

4. a) Explain the procedure to obtain magnetization, external and internal characteristics of a series generator.
   b) A 60 kW DC shunt generator has 1600 turns/pole in its shunt winding. A Shunt field current of 1.25A is required to generate 125V at no load and 1.75A to generate 150V at full load. Calculate
   i) The minimum number of series turns/pole needed to produce the required no load and full load voltage as a short-shunt compound generator.
   ii) If the generator is equipped with three series turns/pole having a resistance of 0.02 Ω , calculate diverter resistance required to produce the desired compounding
   iii) Voltage regulation of compound generator
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5. a) Explain clearly why an equalizer connection makes it possible for two compound generators to operate in parallel in stable equilibrium.
   b) Two compound generators G1 and G2 (fitted with an equalizing bar) operating in parallel supply a load of 475 A. The data of these generators are as follows:

	G1	G2
Generated e.m.fs., V	250	254
Series field resistance, ohm	0.004	0.006
Armature resistance, ohm	0.02	0.04

   Determine: i) Current in each armature ii) Current in each series winding iii) The current flowing in the equalizing bar iv) The bus bar voltage
   Neglect the shunt field currents.

6. a) Explain the speed-current, torque-current and speed-torque characteristics of a cumulative compound d.c motor.
   b) A 6-pole, 500- V wave- connected shunt motor has 1200 armature conductors and useful flux/pole of 20 mWb. The armature and field resistance are 0.5 Ω and 250 Ω respectively. What will be the speed and torque developed by the motor when it draws 20 A from the supply mains? Neglect armature reaction. If magnetic and mechanical losses amount to 900 W, find (i) useful torque (ii) output in kW and (iii) efficiency at this load.

7. a) Why is a resistor required in series with the armature of a DC motor at the time of stating? Describe a suitable starter for starting a DC shunt motor having No-volt and overload protections.
   b) A 240V shunt motor has an armature current of 15 A when running at 800 rpm against full-load torque. The armature resistance is 0.6 Ω. What resistance must be inserted in series with the armature to reduce the speed to 400 rpm at the same torque? What will be the speed if the load torque is halved with this resistance in the circuit? Assume flux to remain constant throughout.

8. a) Explain how Hopkinson's test is carried out on a d.c machine to find its efficiency.
   b) A 400 V, 20 kW dc shunt motor takes 2.5 A when running light. For an armature resistance of 0.5 Ω, field resistance of 800 Ω and brush drop of 2 V, find the full-load efficiency.

Code No: R21025 **R10** SET - 4

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Time: 3 hours Max. Marks: 75

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1. a) For a singly excited magnetic system, derive the relation for the magnetic stored energy in terms of reluctance.

   b) The λ-i relationship for an electromagnetic system is given by $i = \left(\frac{\lambda_g}{0.09}\right)^2$ which is valid for the limits 0<i<4 A and 3<g<10 cm. For current i = 3 A and air gap length g= 5 cm, find the mechanical force on the moving part using energy and co-energy of the field.

2. a) Explain the principle of operation of a d.c. generator and derive its emf equation.
   b) An 8-pole lap wound generator armature has 960 conductors, a flux of 40 mWb and a speed of 400 r.p.m. Calculate the e.m.f generated on open circuit. If the same armature is wave wound, at what speed must it be driven to generate 400 volts?

3. a) Explain clearly the function of interpoles and compensating windings in a dc machine.
   b) A 6-pole lap connected d.c generator having a commutator ring of diameter 45 cm runs at 1000 r.p.m. The brush width is 2 cm and thickness of mica insulation is 0.2 cm. The load current delivered by generator is 115 A and the shunt field current is 5 A. The self-inductance of each coil is 0.1 mH. Determine the reactance voltage if commutation is linear.

4. a) Explain the procedure to obtain O.C.C of a compound generator.
   b) The following data pertains to the magnetization curve of a D.C shunt generator at 300 r.p.m.

I_f in Amps	0	0.2	0.3	0.4	0.5	0.6	0.7
E_G in Volts	7.5	93	135	165	186	202	215

   The field resistance of the machine is adjusted to 354.5 Ω and the speed is 300 rpm.
   For this generator,
   i) Determine the no-load generated voltage.
   ii) Determine the critical value of the shunt field resistance.
   iii) Determine the critical speed for the given shunt field resistance.
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5. a) Explain carefully the exact procedure for connecting a compound generator in parallel with another compound generator already supplying a load.
   b) Explain how internal and external characteristics are obtained for a d.c. compound generator. Also explain why differential compound generator is not preferred over other d.c. generators.

6. a) Explain he significance of Back emf in DC motors.
   b) A 200 V shunt motor has armature resistance = 0.1 Ω, shunt field resistance = 240 Ω and rotational loss = 236 W. On full load the line current is 9.8 A with the motor running at 1450 rpm. Determine
   (i) The mechanical power developed (ii) The power output
   (iii) The load torque (iv) The full-load efficiency

7. a) Explain with circuit diagram the armature voltage control method of speed control in dc motors.
   b) A 20 kW, 500 V shunt motor has an efficiency of 90 % at full-load. The armature copper loss is 40 % of the full-load loss. The field resistance is 250 Ω. Calculate the resistance values of a 4-section starter suitable for this motor if the starting current is limited to two times full load current.

8. a) Explain the procedure to conduct Field's test on series machines in order to determine efficiency.
   b) Hopkinson's test was used to test two shunt machines. The supply current was 15 A at 200 V. The generator output current was 85 A. The field currents for motor and generator were 2.5 A and 3 A respectively. The armature resistance of each machine was 0.05 Ω. Find the efficiency of each of the machines under the above loading conditions.