Code No: W0221 **R07** SET - 1

II B. Tech I Semester Supplementary Examinations May – 2013
ELECTRICAL MACHINES - I
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Derive an expression for the magnetic force developed in a multiply-excited translational magnetic system.
   b) A solenoid of 300 turns is wound on a continuous ring of magnetic material of relative permeability 1000. If the flux density in the magnetic material of the core in the solenoid is 1.3T, what is the current in the solenoid? Mean diameter of the solenoid is 100 mm.

2. a) Enumerate all the parts of a D.C machine and indicate their function.
   b) A six pole lap wound D.C generator has 720 conductors; a flux of 40 mWb per pole is driven at 400 r.p.m. find the generated e.m.f.

3. a) What do you mean by armature reaction in DC machines? Show on a diagram its effect on the flux distribution.
   b) A 4-pole, 50 kW, 250 V wave wound shunt generator has 400 armature conductors. Brushes are given a lead of 4 commutator segments. Calculate the demagnetising amp-turns/pole if shunt field resistance is 50 ohm. Also, Calculate extra shunt field turns/pole to neutralize the demagnetisation.

4. Describe with relevant diagrams, the different methods of excitations of DC machines.

5. a) Explain the function of equalizer bar?
   b) Two shunt generators are operated in parallel. The e.m.f induced in one machine is 260V and that induced in the other machine is 270V. They supply together a load current of 1800A. If the each machine has an armature resistance of 0.04Ω and field resistance 50Ω, Determine: i) Terminal voltage and ii) Output of each machine

6. a) Derive speed-torque characteristics of DC shunt, series and cumulative compound motors.
   b) Sketch these characteristics in one figure on the assumption of i) same speed at no-load and ii) rated speed at rated torque. Comment on the nature of these characteristics.

7. a) Explain the factors that affect the speed of a DC motor.
   b) A DC series motor with unsaturated magnetic circuit and negligible resistance, when running at a certain speed on a given load, takes 50A at 500V. If the load torque varies as the cube of the speed, find the resistance to be inserted to reduce the speed by 50%.

8. a) What are the various losses occurring in rotating machines? Explain the methods to reduce them.
   b) A 500V DC shunt motor takes 4A at no-load. Its armature resistance is 0.2 Ω and the field current is 1A. Estimate the output and efficiency of motor when the input current is 20A.
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Code No: W0221 **R07** SET - 2

II B. Tech I Semester Supplementary Examinations May – 2013
ELECTRICAL MACHINES - I
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
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1. a) For a singly excited magnetic field system, derive the relation for the magnetic stored energy.
   b) The self and mutual inductance of the two existing coils of a multiply-excited translator system are: $L_{11}=L_{22}= 3.6/(1+2x)$; $L_{12}= L_{21}= 1.8/(1+2x)$ Calculate the time average force and coil currents at x=0.4m when
   i) Both the coils are connected in series across a voltage source of 100 cos 314t;
   ii) Both the coils are connected in parallel across a voltage source of 100 cos 314t;

2. a) Give the constructional features and working principle of a D.C generator.
   b) The armature of a 6-pole D.C generator has a wave winding containing 650 conductors. Calculate the generated e.m.f when the flux per pole is 0.055 Wb and the speed is 300 r.p.m. Calculate speed at which the armature must be driven to generate an e.m.f of 550 V if the flux per pole is reduced to 0.05 Wb.

3. a) What are the causes of sparking at brushes in DC machines?
   b) A 4-pole wave wound DC generator with 720 armature conductors delivers 50 A. Find:
   i) Cross-magnetising and demagnetising AT /pole if the brushes are in the geometric neutral plane.
   ii) Cross-magnetising and demagnetising AT /pole if the brushes are shifted by 8^0 electrical from the geometric neutral plane.
   iii) The Cross-magnetising and demagnetising AT /pole if the angle of shift of the brushes is 8^0 actual. [Hint θ_m=0].

4. A 4-pole compound generator has armature, series field and shunt field resistances of 1Ω, 0.5Ω and 100Ω respectively. This generator delivers 4kW at a terminal voltage of 200 V. Allowing 1 V per brush for contact drop, calculate for both short-shunt and long shunt connections
   i) The generated e.m.f and
   ii) The flux per pole if the armature has 200 lap-connected conductors and is driven at 750 rpm.
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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) What is a compound generator? Differentiate between over, level and differential compounding.

6. a) Explain why the e.m.f. generated in the armature of a dc motor is called 'back e.m.f.'
   b) A 22.38 kW, 440 V, 4-pole wave wound DC shunt motor has 840 armature conductors and 140 commutator segments. Its full load efficiency is 88% and the shunt field current is 1.8 A. If brushes are shifted backward through 1.5 segments from the geometrical neutral axis, find the demagnetising and distorting amp-turns/pole.

7. a) How does the speed of a DC shunt motor controlled by armature voltage and field flux? Explain the principles and the state the limitations of the two methods.
   b) A 230 V DC shunt motor runs at 800 rpm and takes armature current of 50 A. Find the resistance to be added to the field circuit to increase speed to 1000 rpm at an armature current of 80 A. Assume flux proportional to field current. Armature resistance =0.15 Ω and field winding resistance =250 Ω.

8. a) Explain the Swinburne test to determine no-load losses of a DC machine. What are the limitations of this test?
   b) In a brake test on a dc shunt motor, the load on one side of the brake band was 35kg and the other side 5kg. The motor was running at 1300 rpm; its input being 70 A at 420 V dc. The pulley diameter is 1m. Determine the torque, output of the motor and the efficiency of the motor.

Code No: W0221 **R07** SET - 3

II B. Tech I Semester Supplementary Examinations May – 2013
ELECTRICAL MACHINES - I
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
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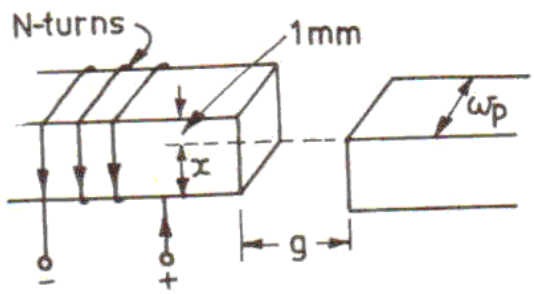
1. a) Explain briefly an electromechanical energy conversion device with the help of a block diagram.
   b) A movable part of an electromagnet is displaced axially by an amount of 1 mm as shown in figure below. If the gap-length g, equal to 3mm, is held constant, find the force tending to bring them into axial alignment. The other data are given below
   Pole width, w_p=6 mm
   Flux density in the air-gap= 0.8Wb/m^2



2. a) Derive the e.m.f equation of a D.C generator
   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 it must be driven to generate 400 volts?

3. a) Explain the following methods of improving commutation:
   i) Resistance commutation and ii) E.m.f commutation
   b) A 6-pole 40 kW, 500 V, wave connected DC generator has 480 conductors on its armature. The brushes are shifted by an angle of 9 mechanical degrees to eliminate sparking on the commutator when delivering full load current. Calculate
   i) Demagnetising ampere turns/pole and ii) Cross-magnetising ampere-turns/pole.

4. a) What features of dc series generator distinguish it from other types of dc generators? Explain.
   b) A separately excited generator with constant excitation is connected to a circuit having constant resistance. When the speed is 750 r.p.m. it delivers 100A at 250V. If the speed is reduced to 600 r.p.m will there be any change in current? Find the value of new current. Armature resistance =0.08 ohm contact drop / brush = 1V. Ignore armature reaction.
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5. Draw the external characteristics of various types of DC generators in one figure assuming the same no-load terminal voltage. Discuss the nature of these characteristics and compare them.

6. a) Derive an expression for the torque of a D.C. motor?
   b) A 5kW, 250V DC shunt motor takes a no-load armature current of 4A at rated voltage and runs at 1200r.p.m. The armature circuit resistance is 0.4 ohm and field resistance is 250 ohm. At rated load and rated voltage, the motor takes 26A and the armature reaction weakens the field flux by 3%. Calculate the full-load speed and the corresponding electromagnetic torque of the motor.

7. a) What are the different methods of speed control of a DC motor? Give the advantages and disadvantages of each in brief. Why is it dangerous to uncouple the mechanical load of a DC series motor?
   b) A series motor is taking 25A from a 220 V supply. The total resistance of the armature and field circuit is 0.5 Ω. Calculate the resistance to be connected in series with the armature to reduce the speed by 40 percent, if the torque is proportional to the square of speed and flux is proportional to current.

8. Hopkinson's test on two shunt machines gave the following results for full load: line voltage 250 V, line current excluding field current 50 A; motor armature current 380 A; field currents 5 A and 4.2 A. Calculate the efficiency of each machine. The armature resistance of each machine = 0.02 Ω.

Code No: W0221 **R07** SET - 4

II B. Tech I Semester Supplementary Examinations May – 2013
ELECTRICAL MACHINES - I
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 80

Answer any **FIVE** Questions
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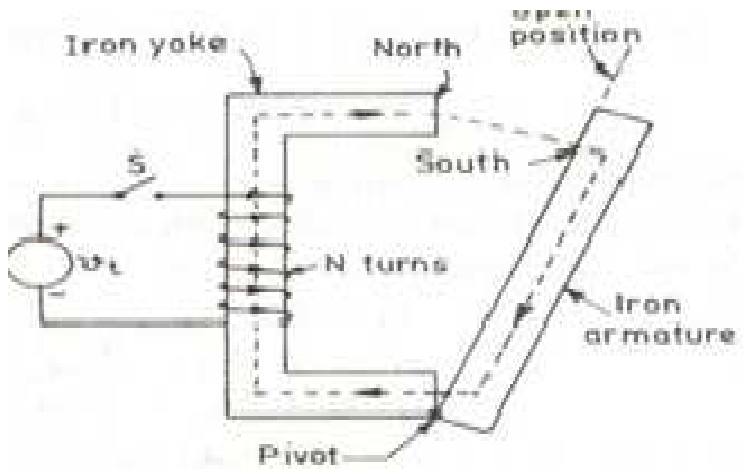
1. a) Discuss briefly "Principle of energy conversion"?
   b) For the simple magnetic relay of figure shown below, the variation of flux linkage ψ in terms of current 'i' and displacement x from the open position is given by the relation $\psi = ix^{1/2}$. Obtain an expression for the magnetic force.



2. a) Give the materials and function of the following parts of a D.C machine:
   i) Field poles ii) Yoke iii) Commutator iv) Commutating poles and v) Armature
   b) Draw the developed winding diagram of lap winding for 6 poles, 18 slots with two coils sides/slot, double layer showing therein position of poles, direction of motion, direction of generated e.m.f and position of brushes.

3. a) Give the concept of reactance voltage in DC machines. Discuss how reactance voltage causes under commutation in DC machines.
   b) A 200 kW, 8-pole wave connected 440 V shunt generator has 720 armature conductors and a shunt field current of 7.5 A. Find the demagnetising and cross-magnetising AT/pole, if the brushes are give a lead of 20 electrical degrees. Find the number of additional shunt field turns to neutralize the demagnetising effect.
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4. Define the terms critical resistance and critical speed and bring out their roles in the process of self-excitation of DC machines. The open circuit characteristic for a dc shunt generator at 800 r.p.m is given by following data:

$I_{f,\ amp.}$	0	0.2	0.40	0.65	1.02	1.75	3.15	5.00
$E_{a,\ volts}$	10	40	80	120	160	200	240	260

Determine the critical field resistance at i) 800 r.p.m and ii) 900 r.p.m.

5. a) Draw the external characteristic of series generator. Why does the terminal voltage starts decreasing after a certain value of load current?
   b) What conditions must be fulfilled before a series generator is connected in parallel with another?

6. a) What is the working principle of a D.C. motor? "In every D.C. generator motor action occurs and in every D.C. motor a generator action occurs". Explain.
   b) A 4-pole dc series motor has wave- connected winding with 600 conductors. Total resistance of motor is 0.8 ohm. When fed from 250V dc source, the motor supplies a load of 10kW and takes 50A with a flux /pole of 3m Wb. For these operating conditions, calculate developed torque and the shaft torque.

7. Explain why a starter is required for starting a DC motor. Describe a 3-point starter having a No-volt and over-load protection for starting a DC shunt motor.

8. a) Briefly describe the Field test on DC series motor.
   b) A 500V DC shunt motor takes 4A at no-load. Its armature resistance is 0.2 Ω and the field current is 1A. Estimate the output and efficiency of motor when the input current is 100A.