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

II B. Tech I Semester Supplementary Examinations, September - 2014
ELECTRICAL MACHINES - I
(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) Define the field energy and co-energy. What is the significance of co-energy?
   b) Explain the mechanical energy and work done in singly excited system when actual displacement occurs?

2. a) Design and draw a 2 layer progressive duplex lap winding for a 4-pole DC generator with 16 slots, each having 2 coil sides. Indicate the position of the brushes and their polarities.
   b) Explain the different methods of excitation of DC generators.

3. a) What is armature reaction? What are the effects of armature reaction? How the armature reaction is minimized.
   b) Explain process of commutation in a DC machine and discuss the methods to improve it.

4. a) Draw the OCC of a DC shunt generator and define critical speed and critical resistance.
   b) A DC shun generator can operate under short circuit conditions but a series and cumulative compound generators cannot operate under this condition. Explain the reason.

5. a) Why usually parallel operation of series generators is unstable? What remedial measures are taken for its successful operation?
   b) Two DC shunt generators are operating in parallel have linear characteristics. One machine has a terminal voltage of 270 V on no load and 220 V at a load current of 30 A. The other machine has a voltage of 280 V on no load and 220 V at a load current of 40 A. Calculate the output current of each machine and the bus voltage when (i) the total load current is 50 A and (ii) load resistance is 10 ohms.

6. a) Explain the armature reaction in a DC motor. Indicate few remedies to its adverse effects.
   b) Explain the speed-current, torque-current and speed-torque characteristics of dc shunt motor. Also explain its applications.

7. a) Explain with a neat sketch how speed control of a DC motor is done by Ward Leonard method. How the direction of rotation of the motor is usually reversed in this method. Discuss its merits and demerits over other methods.
   b) A 220 V shunt motor has an armature resistance of 0.4 ohms. The starting armature current must not exceed 45 A. If the number of sections is 5, calculate the values of resistance steps to be used in the starter.

8. a) Explain the Swinburne's test to determine the no load losses of a DC machine. What are the limitations of this test?
   b) A Field's test on two mechanically coupled DC series motors (with their field windings connected in series) gave the following test data.
   Motor: Armature current: 50A; Armature Voltage: 500V; Field winding voltage drop: 38V.
   Generator: Armature current: 38 A; Armature Voltage: 400 V; Field winding voltage drop: 36V. Resistance of each armature is 0.2 ohms. Calculate the efficiency of each machine at this load.

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

II B. Tech I Semester Supplementary Examinations, September - 2014
ELECTRICAL MACHINES - I
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. Show that in a singly excited system the mechanical work done is equal to the area enclosed between the two ψ-i characteristics in initial and final position and the vertical ψ-i locus during the slow movement of the rotor.

2. a) Draw the developed winding diagram of progressive lap winding for 4-poles, 24 slots with one coil per slot, single layer showing there the position of poles, direction of motion, direction of induced e.m.f and position of the brushes.
   b) What is the need of commutator in a DC machine? Explain the action of commutator in a DC machine.

3. a) How demagnetizing and cross-magnetizing ampere-turns per pole are calculated in a DC machine.
   b) A 4 pole, 23.75 kW, 250 V lap wound dc shunt generator has 50 slots with 8 conductors per slot and a shunt field resistance of 50 ohms. The brushes are given a lead of 8^0 (mechanical) when the generator delivers full load current. Calculate the number of turns on the compensating winding if the pole arc/pole shoe pitch ratio is 0.8.

4. Draw and explain the internal and external characteristics of shunt, series and compound generators.

5. a) Explain the process of paralleling two dc compound generators.
   b) Two DC shunt generators with emfs of 120 V and 115 V, armature resistances of 0.05 ohms and 0.04 ohms and field resistances of 20 ohms and 25 ohms respectively are in parallel supplying a load of 25 kW. How do they share the load?

6. a) What is meant by back e.m.f? Is the back e.m.f greater or lesser than the applied voltage? Why? By what amount do the two voltages differ? Write the voltage equation of the motor.
   b) Determine: i) the total torque developed ii) the useful torque of a 250 V, 4 pole series motor with 782 wave connected conductors developing 8 kW and taking 40 A with a flux per pole of 25 mWb. The armature resistance of the motor is 0.75 ohms.

7. a) With a neat diagram, explain the operation of a 4-point starter. Discuss the advantages of 4-point starter over 3-point starter.
   b) A 220 V shunt motor has an armature resistance of 0.5 ohms and takes an armature current of 40 A on a certain load. By how much the main flux be reduced to raise the speed by 50 % if the developed torque is constant. Neglect the saturation and armature reaction.

8. a) Explain the Hopkinson's test for determination of efficiency of shunt machines.
   b) A retardation test on a DC motor gave the following results: With the field unexcited, the speed fell from 1530 to 1470 in 43 second; with field normally, the same drop in speed occurred in 26 seconds; with an average load of 1.2 kW supplied by the armature, the same speed drop occurred in 20 seconds. Determine the moment of inertia of the rotating parts at 1500 rpm and the core loss for normal excitation at this speed.

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

II B. Tech I Semester Supplementary Examinations, September - 2014
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(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) Distinguish between singly excited system and doubly excited system.
   b) For a singly excited linear magnetic system, derive an expression for the electromagnetic torque.

2. a) Draw up the winding table for a 4 pole, wave connected armature having 30 coil sides and give the developed diagram of the winding showing the polarity and position of the brushes, the main poles and the direction of motion of the armature for a dc motor.
   b) Discuss, in brief, the constructional details of a DC machine.

3. a) Explain the methods of improving commutation with relevant figures.
   b) A 4-pole DC generator supplies a current of 143A. It has 492 armature conductors. When delivering full load, the brushes are given an actual lead of 10^o. Calculate demagnetizing ampere turns per pole and number of extra field turns to neutralize the demagnetization when the machine is i) lap connected ii) wave connected. Assume the machine is shunt machine with I_{sh}=10A.

4. a) What are the various possible causes for DC shunt generator not to build up voltage? Give the remedial measures for voltage build up.
   b) Explain why the external characteristics of a self DC shunt generator is more drooping than that of a separately excited generator.

5. a) Explain clearly the importance of equalizer bar for satisfactory operation of compound generator.
   b) Two DC shunt generators run in parallel to supply together 2500 A. The machines have armature resistance of 0.04 ohms and 0.025 ohms, field resistance of 25 ohms and 20 ohms and induced emfs of 440 V and 420 V respectively. Find the bus-bar voltage and output of each machine.

6. a) Derive the torque equation of a DC motor.
   b) Neatly sketch i) the speed-load ii) torque-load and iii) speed-torque characteristics of a DC compound motor and explain.
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7. a) Briefly explain various speed control methods of a DC shunt motor. Discuss their relative merits and demerits.
   b) Estimate the number of resistance sections and resistance of each section for the starter of 7.5 kW, 460 V DC series motor. The starting current varies from 1.5 to 2 times full load current. The resistance of the machine measured between terminals is 1.8 ohms and efficiency is 80 %. Assume that the flux density increases by 10 % as the current rises from 1.5 to 2 times the rated full load current.

8. a) Explain the Retardation test to estimate the rotational losses in a DC machine.
   b) A DC machine is rated at 5 kW, 250 V, 2000 rpm. The armature resistance is 1 ohm. Driven from the electrical end at 2000 rpm the no load armature current of the machine is 1.2 A at 250 V with a field winding having a resistance of 250 ohms excited by 1 A. Estimate the efficiency of the machine as a 5 kW generator.

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

II B. Tech I Semester Supplementary Examinations, September - 2014
ELECTRICAL MACHINES - I
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Time: 3 hours Max. Marks: 75

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1. a) What are the advantages of analyzing the energy conversion devices by field-energy concept?
   b) In a electromagnetic relay, the exciting coil has 1200 turns. Cross sectional area of the core is A=6 cm x 6 cm. Neglect the reluctance of the magnetic circuit and fringing effects. With coil current kept constant at 2 A, derive the expression for force on armature as a function of air gap length *x*. Find the work done by the magnetic field when *x* decreases from 1 cm to 0.5 cm by integrating the force.

2. a) Draw the winding table for a 4-pole, wave connected armature having 30 coil sides and give the developed winding diagram showing the polarity of induced e.m.f, positions of brushes and direction of motion.
   b) Derive the e.m.f equation of a DC generator.

3. a) Explain clearly the function of the following in DC machines:
   i) Compensating winding ii) Inter poles
   b) Calculate the reactance voltage for a 4 pole lap wound generator if the speed in rpm is 300 and diameter of the commutator is 1.12 m. Total number of commutator segment are 450. The brush width is 2.25 cm and length of each conductor is 1 m. The effective length of the core is 0.3 m and turns per commutator segment are 2. The full load armature current is given as 900 A.

4. a) Sketch the internal and external characteristics of DC shunt and series generators. What are their fields of application?
   b) What is critical field resistance of DC shunt generator? What is its significance?

5. a) Explain how two shunt generators work in parallel and how they share the load.
   b) Two shunt generators with straight line characteristics are operated in parallel, their no load voltages being 240 V and 245 V respectively. The rating of the above generators are 500 kW at 230 V and 250 kW at 220 V. if the total load supplied is 650 kW, calculate: i) the terminal voltage ii) Power supplied by each machine in kW.
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6. a) Draw and explain different characteristics of a series motor.
   b) Determine the torque developed when a current of 40A passes through armature of a motor with following particulars: lap winding, 320 conductors, 4-pole, pole-shoes 16.2 cm long subtending an angle of 60^0 at the centre, bore radius 16.2 cm, and flux density in air gap 0.8 Tesla.

7. a) Explain the principle of operation of a 3-point starter with a neat diagram. Explain the functions of two coils used in it.
   b) The speed of a 500 V shunt motor is raised from 700 rpm to 1000 rpm by field weakening, total torque remains unchanged. The armature and field resistances are 0.8 ohms and 750 ohms respectively and the current at the lower speed is 12 A. Calculate the additional shunt field resistance required assuming the magnetic circuit to be unsaturated. Neglect all losses.

8. a) Explain about Field's test to determine the efficiency of a series motor.
   b) The Hopkinson's test on two identical dc shunt machines gave the following results for full load: Line voltage: 250 V; Line current excluding field currents: 50 A; Motor armature current: 380 A; Field currents: 5 A and 4.2 A. Draw the circuit diagram and mark the values. Assuming armature resistance of each machine is 0.02 ohms, determine efficiency of each machine.