

Code No: R21025

R10**SET - 1****II B. Tech I Semester Regular Examinations, March – 2014****ELECTRICAL MACHINES - I**

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~

1. a) Show that the torque developed in a doubly-excited magnetic system is equal to the rate of increase of field energy with respect to displacement at constant currents.  
b) Distinguish between singly excited and multi excited magnetic field systems. (8M+7M)
2. a) Draw the neat sketch of a DC generator. State the functions of each part.  
b) A 4-pole DC generator has 1200 armature conductors and generates 250 V on open circuit when running at a speed of 500 rpm. The diameter of the pole-shoe circle is 0.35 m and the ratio of pole arc to pole pitch is 0.7 while the length of the shoes is 0.2 m. Find the mean flux density in the air gap. Assume lap connected armature winding. (7M+8M)
3. a) Explain the process of commutation in a DC machine and describe the methods to improve it?  
b) Derive the expressions for calculating the demagnetizing and cross magnetizing ampere turns per pole in a DC generator with usual notations. (8M+7M)
4. a) Explain in detail how a DC shunt generator builds up its voltage. Discuss the conditions to be satisfied for the buildup of voltage? What limits the voltage to which it can build up?  
b) Sketch the complete load characteristics of a DC series generator and indicate there in the region of operation of the machine as a voltage booster and as a constant current source. (7M+8M)
5. a) Two dc shunt generator are operating in parallel. Their no-load voltages are 260 V and characteristics are linear. At 220 V, generator-1 can deliver 310 kW and generator-2 can deliver 600 kW. Find the total load 'P' and load supplied by each at 250 V.  
b) List out conditions to be satisfied for running two or more DC shunt generators in parallel. (8M+7M)

Code No: R21025

**R10****SET - 1**

6. a) Define torque. Derive the expression for torque developed by a DC motor from fundamentals.  
b) Explain speed-current, torque-current, speed-torque characteristics of DC compound motor. (7M+8M)
7. a) What is the need of the starter? With a neat diagram explain the construction and working of 3-point stator.  
b) A 400 V DC shunt motor taking an armature current of 66.67 A on full load. Calculate number of resistance sections, and resistance of each section, when  $R_a=0.5$  ohms and  $I_a$  should not exceed more than 100 A. (7M+8M)
8. a) Describe the Swinburne's test to determine no-load losses of a DC machine. What are the limitations of this test?  
b) A field test on two mechanically coupled DC series motors (with their field windings connected in series) gave the following test data:  
**Motor:** armature current=50A, voltage across armature=500V, voltage across field=38V.  
**Generator:** terminal voltage = 400 V, armature current = 50 A, voltage across field = 36 V.  
Armature resistance (including brushes) of each machine is 0.2 ohms.  
Calculate efficiency of each machine at this load. (7M+8M)

Code No: R21025

**R10****SET - 2****II B. Tech I Semester Regular Examinations, March – 2014****ELECTRICAL MACHINES - I**

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions  
All Questions carry **Equal** Marks  
~~~~~

1. a) Explain briefly an electromechanical energy conversion device with the help of a block diagram.
b) For a singly excited magnetic system, derive the relation for the magnetic stored energy in terms of reluctance. (8M+7M)
2. a) Distinguish between self-excited and separately excited DC generators. How self-excited generators are classified? Give their circuit diagrams.
b) An 8-pole generator has 500 armature conductors and has a useful flux per pole of 0.065 Wb. What will be the e.m.f generated if it is lap connected and runs at 100 rpm. What must be the speed at which it is to be driven to produce the same e.m.f if it is wave connected? (7M+8M)
3. a) What is the effect of armature reaction at leading and trailing pole tips of a dc generator? Explain with the help of neat sketches.
b) What is the purpose of compensating windings and interpoles in a DC machine? Explain in detail. (8M+7M)
4. a) What is the critical field resistance of a DC shunt generator. How it is obtained. What is its significance?
b) State the reasons for the droop in terminal voltage of the shunt generator when it is loaded. (8M+7M)
5. a) Explain clearly the importance of an equalizer bar for satisfactory parallel operation of compound generators.
b) Two DC shunt generators with e.m.f's of 125 V and 120 V, armature resistances of 0.04 ohm and 0.03 ohm and field resistance of 15 ohms and 20 ohms respectively are in parallel supplying a total load of 25 kW. How do they share the load? (7M+8M)
6. a) Explain speed-current, torque-current, speed-torque characteristics of a DC series motor.
b) Prove that in a dc generator, generated e.m.f and current in a conductor are in the same direction, whereas in a dc motor, generated e.m.f opposes the flow of current in a conductor. (7M+8M)
7. a) How is 4-point starter is different from 3-point starter. With a neat diagram explain the construction and working of 4-point stator.
b) The armature and field resistances of a 320 V, dc shunt motor are 0.5 Ω and 250 Ω respectively. When driving a load of constant torque at 600 rpm, the armature current is 24 A. If it is required to increase the speed from 600 rpm to 700 rpm, calculate the resistance to be connected in the shunt field circuit. (7M+8M)
8. With the help of neat circuit diagram, explain Hopkinson's test and derive the relations for efficiency (both for generator and motor). Also state the merits and demerits of this method.

(15M)

Code No: R21025

R10**SET - 3****II B. Tech I Semester Regular Examinations, March – 2014****ELECTRICAL MACHINES - I**

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~

1. a) Derive an expressions for field energy and co-energy in a singly-excited electromechanical unit.  
b) Explain the mechanical energy and work done in singly excited system when actual displacement occurs? (8M+7M)
2. a) What is the principle of operation of a DC generator? Why is a commutator and brush arrangement necessary for the operation of a DC generator?  
b) A short-shunt compound DC generator delivers 100 A to a load at 250 V. The generator has shunt field, series field, and armature resistances of 130 ohms, 0.1 ohm, and 0.1 ohm respectively. Calculate the voltage generated in armature winding. Assume 1 V voltage drop per brush. (7M+8M)
3. a) What is armature reaction? Describe the effects of armature reaction on the operation of a DC machine. How the armature reaction is minimized?  
b) What do you understand by linear commutation, under commutation and over commutation in a DC machine? Explain in detail. (8M+7M)
4. a) Explain why external characteristics of a DC shunt generator is more drooping than that of a separately excited generator. Discuss their applications.  
b) What is a critical field resistance of a DC shunt generator? Explain. (8M+7M)
5. a) Why usually parallel operation of series generator is unstable? What remedial measures are taken for its successful operation?  
b) Two shunt generators run in parallel to supply together 2.5 kA. The machines have armature resistances of 0.04 ohms and 0.025 ohms, field resistances of 25 ohms and 20 ohms and induced e.m.fs of 440 V and 420 V respectively. Find the bus bar voltage and output of each machine. (8M+7M)

Code No: R21025

**R10****SET - 3**

6. a) Explain the armature reaction in a DC motor, indicating the remedies to its adverse effects.
- b) A 4-pole, lap wound 410 V series motor has the following data: Number of armature conductors is 960, flux per pole is 0.04 Wb, total motor resistance is 0.5 ohm, iron and frictional losses is 2 kW. If the current taken by the motor is 95 A, find: i) total torque ii) useful torque at the shaft iii) power output iv) pull at the rim of the pulley of 42 cm diameter connected to the shaft. (7M+8M)
7. a) Discuss various methods of speed control that can be used for DC series motors.
- b) Estimate the number of resistance sections and resistance of each section for the starter of 7.5 kW, 460 V DV series motor. The starting current varies from 1.5 to 2 times full-load current. The resistance of the machine measured between the terminals is 1.8 ohms and the 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. (7M+8M)
8. Explain the experimental procedure to conduct Retardation Test on a dc shunt machine with the help of connection diagram. How the different losses are estimated from the test results? (15M)

Code No: R21025

**R10****SET - 4****II B. Tech I Semester Regular Examinations, March – 2014****ELECTRICAL MACHINES - I**

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions  
All Questions carry **Equal** Marks  
~~~~~

1. a) What is the significance of energy and co-energy in energy conversion system.
b) Describe the principle of energy-conversion. From a consideration of the various energies involved, develop the model of an electro mechanical conversion device. (7M+8M)
2. a) Derive the e.m.f equation of a DC generator. Discuss the factors affecting the generated e.m.f.
b) A six pole lap wound dc armature has 60 slots with 18 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. (7M+8M)
3. a) What is reactance voltage? How is it neutralized in a DC machine? Discuss the effect of reactance voltage on the operation of a DC machine.
b) A 220 kW, 4-pole wave connected, 440 V shunt generator has 740 conductors and a shunt field current of 10 A. Find the demagnetizing and cross magnetizing ampere turns per pole, if the brushes are given a lead of 25 electrical degrees. Find the number of additional shunt field turns to neutralize the demagnetizing effect. (7M+8M)
4. a) Draw and explain internal and external characteristics of series and compound generator.
b) Define the critical speed and critical resistance. Explain how these are determined from OCC of the DC shunt generator and explain the buildup of voltage? (7M+8M)

Code No: R21025

R10**SET - 4**

5. a) Two shunt generators operating in parallel deliver a total current of 250 A. One of the generators is rated 50 kW and the other 100 kW. The voltage ratings of the both the machines is 500 V and have regulations of 6% (smaller one) and 4%. Assuming linear characteristics, determine i) the current delivered by each machine ii) terminal voltage.
b) Explain with connection diagrams how two DC compound generators are operating in parallel. (8M+7M)
6. a) Explain the principle of operation of DC motors?
b) Calculate the torque developed when a current of 15 A passes through a armature of a motor with the following particulars: 560 conductors, lap wound, 4-poles, pole shoes 15 cm long subtending an angle 60° at the center, core radius 14 cm and flux density in the air gap is 1.7 Tesla. (7M+8M)
7. a) Explain with neat sketch how speed control of a DC shunt motor is done by Ward Leonard control system. How the direction of rotation of the motor is usually reversed in this method of speed control.
b) Discuss the applications of different types of DC motors. (8M+7M)
8. a) Explain the procedure to conduct Field's test on series machines in order to determine efficiency.
b) A retardation test is made on a separately excited DC machine as a motor. The induced voltage falls from 240 V to 225 V in 25 seconds on opening the armature circuit and 6 seconds on suddenly changing the armature connection from supply to a load resistance taking 10 A (average). Find the efficiency of the machines when running as a motor and taking a current of 25 A on a supply of 250 V. The resistance of the armature is 0.4 ohms and that of its field winding is 250 ohms. (7M+8M)