

Code No: RT21026

R13**SET - 1**

II B. Tech I Semester Supplementary Examinations, June - 2015
ELECTRICAL MACHINES-I
(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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**PART -A**

- 1 a) Give applications of Singly excited system? (3)
- b) Name the parts of the dc machine, which are laminated to be operated through a power electronics converter? (4)
- c) Distinguish between internal and external characteristics of a dc generator? (4)
- d) Discuss the significance of back e.m.f. in a d.c. motor? (4)
- e) Compare the merits and demerits associated with each method of speed control of dc motor? (4)
- f) List the advantages and disadvantages of high number of poles in dc machine? (3)

**PART -B**

- 2 a) Prove that energy and co-energy in a linear magnetic system are given by identical expressions. (8)
- b) 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 (8)
- 3 a) Derive an expression for the emf generated in a dc machine? (8)
- b) A 10 kW, 250 V, 8-pole, 600 r.p.m lap-connected d.c. generator has 400 armature conductors. At rated voltage and current, armature ohmic losses are 150 watts. Compute the useful flux per pole? (8)

Code No: RT21026

**R13**
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- 4 a) Explain the voltage build up process in d.c. shunt generator? (8)
- b) The open circuit characteristic for a d.c. shunt generator at 800 r.p.m is given by the following data. (8)

|          |    |     |     |      |      |      |      |     |
|----------|----|-----|-----|------|------|------|------|-----|
| $I_f(A)$ | 0  | 0.2 | 0.4 | 0.65 | 1.02 | 1.75 | 3.15 | 5.0 |
| $E(V)$   | 10 | 40  | 80  | 120  | 160  | 200  | 240  | 260 |

Determine the critical field resistance at 900 r.p.m.

- 5 a) Explain with a neat diagram the working of a three point starter used for d.c. shunt motor? (8)
- b) A 20 KW, 250 V dc shunt motor has a full-load armature current of 85 A at 1100 rpm. The armature resistance is 0.18 ohm. Determine (a) the initial torque developed; (b) the internal torque if the field current is suddenly reduced to 80% of its original value (8)
- 6 The Hopkinson's test on two similar machines gave the following data. Line Voltage =230 V; line current excluding both the field currents 40A, motor armature current=350A The field currents are 5A and 4.2A. Armature resistance of each machine is 0.02 ohms. Calculate the efficiency of each machine assuming a brush contact drop of 1V per brush. (16)
- 7 Find main dimensions and the number of poles of a 37 kW, 230V,1400 rpm., shunt motor so that a square pole face is obtained. The average gap density is  $0.5 \text{ Wb/m}^2$  and the ampere conductors per meter are 22000. The ratio of pole arc to pole pitch is 0.7 and the full load efficiency is 90%. (16)

Code No: RT21026

**R13****SET - 2**

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PART -A

- 1 a) Define field energy and co-energy? (3)
- b) What is the purpose of compensating winding? Explain? (4)
- c) Draw the external characteristics of series, shunt and separately excited generator in the same plot and compare them? (4)
- d) What is the difference between speed regulation and speed control? (4)
- e) Explain the significance of Swinburne's test in brief? (4)
- f) List the factors to be considered for selecting number of armature slots? (3)

PART -B

- 2 a) What are the significances of energy and co-energy in Energy conservation system? (8)
- b) Derive expression for the magnetic force developed in linear electromagnetic system (8)
- 3 a) What is an equalizer connection? What is necessity of equalizer connection? (8)
- b) An 8 pole DC generator has per pole flux of 40mWb and winding is connected in lap with 960 conductors. Calculate the generated EMF on open circuit when it runs at 400 rpm. If the armature is wave wound, at what speed must the machine be driven to generate the same voltage. (8)

Code No: RT21026

R13**SET - 2**

- 4 a) Distinguish between external and internal characteristics of a d.c. generator. (8)
Explain, with appropriate diagrams, how the internal characteristics can be obtained from the external characteristics of the series and shunt generators?
- b) A d.c. shunt generator is supplying load connected to a bus - bar voltage of 220 V. (8)
It has an armature resistance of 0.025Ω and field resistance of 110Ω . Calculate the value of load current and load power when it generates an e.m.f of 230 V. Neglect the effect of armature reaction. Draw circuit diagram.
- 5 a) Explain the construction and operation of 3-point starter used for starting of d.c. (8)
motor?
- b) A 4-pole, 250 V series motor has a wave-connected armature with 1254 (8)
conductors. The flux per pole is 22 mWb when the motor is taking 50 A. Iron and friction losses amount to 1.0 kW. Armature resistance is 0.2 ohm and series field resistance is 0.2 ohm. Calculate: i) the speed ii) the shaft torque and
iii) the efficiency at this load.
- 6 a) Describe and compare various methods of speed control of dc motors? (8)
- b) A DC shunt motor runs at 750 rpm from 250 V supply and is taking a full load line (8)
current of 60 A. Its armature and field resistances are 0.4Ω and 125Ω respectively. Assuming 2 V brush drop and negligible armature reaction effect, calculate the no load speed for a no load line current of 6 A and resistance to be added in series with armature circuit to reduce the full load speed to 600 rpm.
- 7 Find main dimensions and the number of poles of a 37 kW, 230V, 1400 rpm., shunt (16)
motor so that a square pole face is obtained. The average gap density is 0.5 Wb/m^2 and the ampere conductors per meter are 22000. The ratio of pole arc to pole pitch is 0.7 and the full load efficiency is 90%.

Code No: RT21026

R13**SET - 3****II B. Tech I Semester Supplementary Examinations, June - 2015****ELECTRICAL MACHIENS-I**

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**PART -A**

- 1 a) List the differences between singly excited and doubly excited magnetic systems (3)
- b) What are interpoles? What is the purpose of interpoles? (4)
- c) Define critical speed? Explain its significance? (4)
- d) Sketch the speed- torque characteristics of dc shunt, series and cumulative compound motors in one figure and comment on the nature of characteristics. (4)
- e) Enumerate various losses in a dc motor? Derive the expression efficiency of dc motor? (4)
- f) The total weight of iron in d.c. machine decreases with increase in number of poles. Explain? (3)

**PART -B**

- 2 a) Derive expressions for field energy, co-energy and magnetic force in a singly-excited electromechanical unit. (8)
- b) Derive an expression for reluctance torque in a rotating electrical machine (8)
- 3 a) What is meant by armature reaction? Explain the effect of armature mmf on the main filed flux can be described with the help of magnetization curve of a d c machine? (8)
- b) A 4-pole, wave connected armature has 100 slots. If the flux per pole is 0.04 Wb, calculate the number of conductors required per slot to generate 220 V. Take the speed of the generator as 300 rpm. Calculate the new value of the flux due to change in the number of conductor per slot, if any. (8)

Code No: RT21026

**R13****SET - 3**

- 4 a) Explain experimental determination of critical field resistance for a self excited generator? (8)
- b) A 10 kW, 250 V d.c. shunt generator has total no-load rotational loss of 400 W. The armature circuit resistance and shunt field resistances are  $0.5 \Omega$  and  $250 \Omega$  respectively. Calculate the shaft power input and the efficiency at rated load? (8)
- 5 a) Distinguish between motor and generator action. Derive the equation for the back e.m.f induced in a DC motor (8)
- b) A 4 pole dc series motor has wave connected winding with 600 conductors. Total resistance of the motor is  $0.8 \Omega$ . When fed from 250 V source, dc motor supplies a load of 10 kW and takes 50 A with a flux per pole of 3 mWb. For these operating conditions calculate the developed torque and the shaft torque. (8)
- 6 a) Explain the swinburne's test on a dc machine and hence explain how the test data is useful to calculate the efficiency of the machine at any desired load? (8)
- b) A 400 V d.c. shunt motor takes 5 A at no-load.  $R_a=0.5 \Omega$  and  $R_{sh}=200 \Omega$ . Estimate the kW output and efficiency when the motor takes 50 A on full load. (8)
- 7 Find the main dimensions of a 200 kW, 250 V, 6-pole, 1000 rpm generator. The max. value of flux density in the gap is  $0.87 \text{ Wb/m}^2$  and the ampere conductors per meter of armature periphery are 31000. The ratio of pole arc to pole pitch is 0.67 and the efficiency is 91%. Assume the ration of length of core to pole pitch is 0.75. (16)

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**R13****SET - 4****II B. Tech I Semester Supplementary Examinations, June - 2015****ELECTRICAL MACHINES-I**

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PART -A

- 1 a) From construction point of view, enumerate the common essential features of rotating electrical machines? (3)
- b) What are the two functions of a commutator in dc machines? (4)
- c) Define critical field resistance? Explain its significance? (4)
- d) What is the need of starter for dc motor? (4)
- e) What is meant by constant torque drive and constant power drive? (4)
- f) The total weight of field copper in d.c. machine decreases with increase in number of poles. Explain? (3)

PART -B

- 2 a) Draw and explain fully the general block diagram representation of an electromechanical energy conversion device. (8)
- b) For a singly excited magnetic system, derive the relation for the magnetic stored energy in terms of reluctance. (8)
- 3 a) Explain about demagnetizing Ampere turn per pole and Cross magnetizing Ampere Turn per pole. (8)
- b) Show that emf induced in a coil undergoing commutation is given by $\frac{2I_a / a}{T_c}$, where (8)
 I_a is the armature current and T_c is the commutation period.

Code No: RT21026

R13**SET - 4**

- 4 a) Draw the external characteristics of various types of d.c. generators in one figure (8)
assuming the same no-load terminal voltage. Discuss the nature of these characteristics and compare them.
- b) A separately excited generator with constant excitation is connected to a constant (8)
load. When the speed is 1500 rpm, it delivers 120A at 500V. At what speed will the current be reduced to 60 A? Armature resistance is 0.1ohm, Contact drop/brush is 1V. Armature reaction may be ignored.
- 5 a) Derive the torque equation of dc motor? (8)
- b) A 5kW,250 V dc shunt motor takes a no load armature current of 4 A at rated (8)
voltage and runs at 1200 rpm. The armature circuit resistance is 0.4 Ω and field resistance is 250 Ω . At rated load and rated voltage, the motor takes 26 A and the armature reaction weakens the filed flux by 3%. Calculate the full load speed and the corresponding torque of the motor.
- 6 a) With neat diagram explain the Swinburne's test conducted on DC shunt motors. (8)
What are the advantages and limitations of this test? Enumerate all calculations.
- b) A 230 V DC shunt motor is taking 5 A when running light. The armature resistance (8)
is 0.2 Ω and field circuit resistance is 115 Ω . For an input current of 72 A, calculate the shaft output and efficiency. Also calculate the armature current at which the efficiency is maximum.
- 7 Find the main dimensions of a 200 kW, 250 V, 6-pole, 1000 rpm generator. The (16)
max. value of flux density in the gap is 0.87 Wb/m² and the ampere conductors per meter of armature periphery are 31000. The ratio of pole arc to pole pitch is 0.67 and the efficiency is 91%. Assume the ration of length of core to pole pitch is 0.75.