Code No: R21025 $\boxed{\text{R10}}$ $\boxed{\text{SET - 1}}$

II B. Tech I Semester Supplementary Examinations, June - 2015
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)	Draw and explain fully the general block –diagram representation of an electromechanical energy conversion device	[7]
	b)	The $\lambda - i$ characteristics of single excited electromagnet is given by $i = 121\lambda^2 x^2$,for 0<i<4A and 0<x<10cm. if the air gap is 5cm and a current of 3A is following on the coil, calculate, i) field energy, ii) co-energy and iii) mechanical force on the moving part	[8]
2	a)	Obtain the condition for maximum efficiency of the DC generator	[6]
	b)	A 440V DC shunt generator has a full load current of 220A. The resistance of the armature and field windings are 0.04Ω and 120Ω respectively. The stray losses are 2100W. Find the output of prime mover when it is delivering full load and find the load for which the efficiency of the generator is maximum	[9]
3	a)	A 4-pole generator supplies a current of 143A. It has 492 armature conductors i) wave wound and ii) lap wound. When delivering full load, the brushes are given an actual lead of 10^0. Calculate the demagnetizing amp-turns per pole. This field winding is shunt connected and takes 10A. Find the number of extra shunt field turns to neutralize the demagnetization.	[8]
	b)	Explain the importance of compensating windings in DC machines	[7]
4	a)	Draw and explain the external characteristics of shunt, series and compound generators	[8]
	b)	Explain the process of voltage build up in a DC shunt generator. What is the field circuit critical resistance?	[7]
5	a)	Two DC shunt generators are connected in parallel to supply a load of 5000A. Each machine has an armature resistance of 0.03Ω and field resistance of 60Ω but emf of one machine is 600V and that of the other machine is 640V. What power does each machines supply the statement	[9]
	b)	Two shunt generators having drooping characteristics are best suited for parallel operation. Explain?	[6]

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6 a) What are the various losses occurring in rotating machines. Mention the methods to reduce them.   [7]

   b) A 120V DC shunt motor has an armature resistance of 0.2Ω and a field resistance of 60Ω. The full load line current and full load speed are 60A and 1800 rpm. If the brush contact drop is 3V. Find the speed of the motor at half load.   [8]

7 a) Write short notes on ward-Leonard method of speed control.   [6]

   b) A 250V DC shunt motor with an armature resistance of 0.5Ω runs at 600 rpm on full load and takes an armature current of 20A. If resistance of 1Ω is placed in the armature circuit, find the speed at i) Full load torque ii) half-full load torque.   [9]

8 a) Explain the Swinburne's test to determine no-load losses of DC machine. What is the limitation of this test?   [6]

   b) A 220V Dc shunt motor at no load takes a current of 2.5 A. The resistances of the armature and shunt field are 0.8Ω and 200Ω respectively. Estimate the efficiency of motor when the input current is 20A. State precisely the assumptions made.   [9]

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1 a) With one example derive the co-energy of a multi excited magnetic field system [7]

   b) A soft iron ring of 18cm mean diameter and circular cross-section of 3.5cm diameter is wound with a magnetizing coil. A current of 5A flowing in the coil produces flux of 2.5 mwb in the air gap which is 2.2mm wide. Taking relative permeability to be 1000 at this flux densities and allowing for a leakage co-efficient of 1.2, find the number of the turns on the coil. [8]

2 a) Derive an expression for the emf of a DC generator [7]

   b) Calculate the voltage induced in the armature winding of a 4-pole, lap wound DC machine having 728 active conductors and running at 1800 rpm. The flux per pole is 30 mwb [8]

3 a) Explain the armature reaction and commutation process in detail [9]

   b) A 250V, 14.9kW, 8-pole, DC motor has single turn coils. The armature is wave wound with 94 conductor segments. If the brushes are shifted by 2 commutated segments at full load, calculate i) total armature reaction ampere-turns ii) demagnetizing ampere-turns iii) cross magnetizing ampere-turns. Assume motor efficiency to be 80% [6]

4 a) Draw the performance characteristics of different types of DC generators and explain them. [7]

   b) A shunt generator gave the following results in the OCC test at a speed of 800rpm. The field resistance is adjusted to 50Ω and the terminal voltage is 300V, armature resistance is 0.1Ω and assuming that flux is reduced by 5% due to armature reaction find the load supplied by the generator. [8]

Field current(A)	1	2	3	4	6	8	10
EMF(V)	90	185	251	290	324	345	360

5 a) State four reasons for operating DC generators in parallel [6]

   b) The terminal voltage of a shunt generator G_1 falls from 500V at no load to 470V when delivering a current of 600A, for a second generator G_2 the figures are 505V at no load and 470V at 400A. When connected in parallel generators supply a total load of 400KW. Assuming that the voltage, power characteristics are linear, determine the common bus voltage and the current delivered by each machine. [9]

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6 a) What are the important characteristics of DC motor? Sketch all these characteristics of DC series motors. [9]

   b) A 230 volts series motor is taking 50A. Resistance of armature and series field winding is 0.2Ω and 0.1Ω respectively. Calculate i) Brush voltage, ii) Back EMF, iii) Power wasted in armature and mechanical power developed. [6]

7 a) Explain the working principle of a 3-point starter of a DC shunt motor. [8]

   b) A 240V series motor takes 40A when giving its rated output at 1500rpm. Its resistance is 0.3Ω. Find what resistance must be added to obtain rated torque i) at starting ii) at 1000rpm. [7]

8 a) Determine a suitable method for determining the efficiency of series motor. [6]

   b) A 220V Dc shunt motor at no load takes a current of 2.5 A. The resistances of the armature and shunt field are 0.8Ω and 200Ω respectively. Estimate the efficiency of motor when the input current is 20A. State precisely the assumptions made. [9]

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1 a) Draw and explain the general block diagram of an electromechanical energy conversion device. [7]

   b) A coil is wound on an iron core to form a solenoid. A certain current is passing through the coil which is producing a flux of 40 mwb. The length of magnetic circuit is 75cm which its cross sectional area is $3cm^2$. Calculate the energy stored in the circuit. Assuming relative permeability of iron as 1500. [8]

2 a) With a help of sketch describe the main construction and working principle of DC generators [8]

   b) A DC generator has an armature emf of 100V when the useful flux per pole is 20mwb, and the speed is 800rpm. calculate the generated emf i) with the same flux and the speed of 1000rpm ii) with a flux per pole of 24mwb and a speed of 900rpm [7]

3 a) Develop an expression for the demagnetizing and cross magnetizing ampere turns in a DC generator [7]

   b) A 250KW, 400V, 6-pole, lap connected armature has 720 conductors. It is given a brush lead of 2.5^0 mechanical from its GNA. Calculate the demagnetization and cross magnetization AT/pole. Neglect shunt field current. [8]

4 a) Draw the OCC characteristics and external characteristics of DC generator [7]

   b) A 500V, 250KW long shunt compound generator induces an emf of 480KW when running at 1000rpm on no load. On full load the speed of the machine drops to 975rpm, the flux increases by 15% the terminal voltage to 500V. if the series and shunt filed resistances are 0.02Ω and 100Ω respectively, calculate the armature resistance. Assume a voltage drop of 1V per brush [8]

5 a) Describe the advantages of using several small DC generators in parallel over the uses of single large generators [6]

   b) Two DC shunt generators running in parallel to supply together 2500A. The machine has armature resistance of 0.04Ω and 0.025Ω, field resistances of 25Ω and 20Ω an induced emf of 440V and 420V respectively. Find the bus bar voltage and output of each machine. [9]

6 a) Explain the principle of operation of DC motor. What is the back EMF of DC motor? What is its effect? [7]

   b) A 250V DC shunt motor having an armature resistance of 0.25Ω carrying an armature current of 50A and runs at 750 rpm. If the flux is reduced by 10% find the speed. Assume that the torque remains same. [8]

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7 a) Why is starting current high in a DC motor? Explain the working of a four point starter for a DC machine.   [6]

   b) A DC series motor connected to a 440V supply runs at 600 rpm when taking a current of 50 A. Calculate the values of resistance which when inserted in series with motor will reduce the speed to 400 rpm, the gross torque being then half its previous value. The resistance of motor in 0.2Ω Assume linear magnetism.   [9]

8 a) Explain advantages and disadvantages of Swinburn's test.   [5]

   b) The Hopkinson's test on two similar shunt machines gave the following full load data.
   Line voltage: 110V, field and armature currents are 3A and 3.5A
   Line current: 48A, armature resistance of each is 0.035Ω, motor armature current is 230A;
   Calculate the efficiency of each machine assuming a brush contact drop of 1V per brush.   [10]

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1 a) Explain in detail doubly excited systems   [7]

   b) Two coupled coils have self and mutual inductances of $L_{11} = 3 + 0.5x$, $L_{22} = 2 + 0.5x$, $L_{12} = L_{21} = 0.3x$ over a sustain range of linear displacement. The first coil is excited by constant current of 15A and the second by a constant current of 8A. Mechanical work done if x changes from 0.6 to 1m.   [8]

2 a) Explain with different methods of excitation and characteristics of DC generators with suitable diagram   [7]

   b) A 6-pole DC generator has 150 slots each slot has 8 conductors and each conductor has resistance of 0.01Ω. The armature terminal current is 15A. Calculate the current per conductor and the drop in the armature for lap and wave winding connections   [8]

3 a) Explain the various methods of improving commutation in a dc machine   [7]

   b) A 4-pole, 23.75KW, 250V lap wound DC generator has 8 slots with 8 conductor per slots and shunt field resistance of 50Ω. 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 per pole shoe pitch ration is 0.8   [8]

4 a) What could be the causes of failure of voltage build up of DC self excited generator? How can the problem be remedied?   [7]

   b) A 500V, 250KW long shunt compound generator induces an emf of 480KW when running at 1000rpm on no load. On full load the speed of the machine drops to 975rpm, the flux increases by 15% the terminal voltage to 500V. if the series and shunt filed resistances are 0.02Ω and 100Ω respectively, calculate the armature resistance. Assume a voltage drop of 1V per brush   [8]

5 a) Draw the connection diagram of two shunt generators connected in parallel and discuss their load sharing   [6]

   b) Two DC shunt generators are connected in parallel to supply a load of 5000A. Each machine has an armature resistance of 0.03Ω and field resistance of 60Ω but emf of one machine is 600V and that of the other machine is 640V. What power does each machines supply?   [9]

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6 a) Give the concept of counter EMF in a DC motor. [6]

   b) A 500V DC Shunt motor takes a current of 5A on no-load. The resistances of the field and armature circuit are 250Ω and 0.22Ω respectively. Find i) The efficiency when loaded and taking a current of 100A. ii) The percentage change of speed. State precisely the assumptions made.

[9]

7 a) Make a list of different speed control methods for DC motor. Discuss merits and demerits of each method. [7]

   b) A 220V DC shunt motor has an armature resistance of 0.5Ω. The armature current at starting must not exceed 40 A. If the number of sections is 6, calculate the values of resistor steps to be used in this starter.

[8]

8 a) Explain brake test for determining the efficiency of a DC machine.

[6]

   b) A retardation test is made on a separately excited DC machine as a motor. The induced voltage falls from 240V to 225V in 25 seconds on opening the armature circuit and 6 seconds on suddenly changing the connection from supply to a load resistance taking 10A (average). Find the efficiency of the machine running as a motor and taking current of 25A on a supply of 250V. The resistance of its armature is 0.4Ω and that of its field winding is 250Ω.

[9]