Code No: R2021024 **R20** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, January-2023
DC MACHINES AND TRANSFORMERS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Explain the concept of singly – excited machines and derive the expression for the electromagnetic torque. [7M]

b) A separately excited generator with constant excitation is connected to a constant resistance circuit. When the speed is 1200 rpm it delivers 120A at 500V. At what speed will be the current be reduced to 60A? Armature resistance = 0.1Ω. Contact drop per brush = 1V. Armature reaction may be ignored. [7M]

OR

2 a) What do you understand by demagnetizing and cross magnetizing affects of armature reaction in DC machine? [7M]

b) A shunt generator delivers 50kW at 250V when running at 400rpm. The armature and field resistance are 0.02 Ω and 50 Ω respectively. Calculate the speed of the machine when running as a shunt motor and taking 50kW input at 250V. Allow 1V per brush for contact drop. [7M]

UNIT-II

3 a) Explain the performance characteristics of DC Series Motors. [7M]

b) A 230V, DC shunt motor, takes an armature current at 3.33A at rated voltage and at a no load speed of 1000 rpm. The resistances of the armature circuit and field circuit are 0.3Ω and 160Ω respectively. The line current at full load and rated voltage is 40A. Calculate, at full load, the speed and the developed torque in case the armature reaction weakens the no load flux by 4%. [7M]

OR

4 a) Describe the principle of operation of DC motor. [7M]

b) A 220 V dc shunt motor takes no load current of 10A and runs at 750 rpm. At full load the armature current is 100A and the motor runs at 690 rpm. Resistance of the armature is 0.1 Ω. Calculate the following: (i) back e.m.f at no load and full load (ii) percentage of reduction in flux due to armature reaction. [7M]

UNIT-III

5 a) With suitable diagram, how the Swinburne's test can be employed to predetermine the efficiency at full load condition when running as a (i) generator and (ii) motor [10M]

b) Explain why the series motors should not be started without any load. [4M]

OR
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6 a) From the fundamentals, Obtain the equivalent circuit of a single phase transformer? [7M]

b) A Single-phase transformer is connected to a 230 V, 50 Hz supply. The net cross-sectional area of the core is 60 cm^2. The number of turns in the primary is 500 and in the secondary 100. [7M]
Determine:
i) Transformation ratio. ii) Maximum value of flux density in the core.
iii) E. m. f. induced in secondary winding.

UNIT-IV

7 a) Explain Sumpner's method of testing transformers. Mention its advantages. [7M]

b) A 2200/220 V, single phase transformer has maximum possible voltage regulation of 6% and it occurs at a p.f. of 0.3. Find the load voltage at full-load 0.8 p.f lead. [7M]

OR

8 a) Explain in detail how eddy current and hysterisis losses of a transformer can be minimized. [7M]

b) At 400 V and 50 Hz the core loss of a transformer was found to be 2400 W. When the transformer is supplied at 200 V and 25 Hz, the core loss is 800 W. Calculate the hysteresis and eddy current loss at 400 V and 50 Hz. [7M]

UNIT-V

9 a) Explain in detail about open delta connection of 3-phase transformer and write its applications. [7M]

b) The input current to a 3-phase step down transformer connected to an 11 kV supply system is 14 A. Calculate the secondary line voltage and current for (i) star – star and (ii) delta- star connections. If phase turns ratio is 44. [7M]

OR

10 a) With a neat circuit diagram, discuss how the two phase supply can be obtained from a three phase supply. [7M]

b) Two 110V, 1 - Phase furnaces take loads of 500Kw and 800Kw respectively at a power factor of 0.707 lagging and are supplied from 6600V, 3 – phase mains through a scott connected transformer. Calculate the currents in a 3 – Phase line neglecting the transformer losses. Draw the phasor diagram. [7M]

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UNIT-I

1 a) Derive the expression for field energy produced in a doubly excited magnetic field system [7M]
b) Explain the external characteristics of DC series and shunt generators. [7M]

OR

2 a) Explain with neat sketches, how D.C. Generators are classified. [7M]
b) A 10 KW shunt generator having resistances1Ω and 100Ω, delivers full load at a terminal voltage of 230 V. Determine the efficiency of the generator at full load, assuming the iron, friction and windage losses amount to 500 W. [7M]

UNIT-II

3 a) Explain the working of a DC motor. What is the significance of back EMF in DC motors? [7M]
b) A 460V dc series motor runs at 500 rpm taking a current of 40A. Calculate the speed and percentage change in torque if the load is reduced so that the motor is taking 30A. The total resistance of the armature and field circuits is 0.8Ω. Assume that flux is proportional to the field current. [7M]

OR

4 a) Explain the performance characteristics of DC Shunt Motors. [7M]
b) The armature circuit resistance of a 20 kW 200V series motor is 0.1 Ω. The brush voltage drop is 2V, and the series field resistance is 0.05Ω. When motor takes 50A, the speed is 500 rpm. Calculate the speed when the current is 100A. [7M]

UNIT-III

5 a) Draw and explain the phasor diagram of the transformer when it is operated a lagging and leading loads. [7M]
b) The Hopkinson test on two shunt machines gave the following results for full load: [7M]
Line voltage = 250V, line current excluding field currents = 50A, Motor armature current = 380A, field currents are 5A and 4.2A. Calculate the efficiency of each machine. Armature resistance of each machine 0.02 Ω?

OR

6 a) Explain in detail, how the brake test is conducted on DC Shunt motor? [7M]
b) A series motor, with an unsaturated magnetic circuit and 0.5Ω total resistance, when running at a certain speed takes 60 A at 500 V. If the load torque varies as the cube of the speed, calculate the resistance required to reduce the speed by 25 %. [7M]

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UNIT-IV

7 a) Define all-day efficiency of a transformer. Obtain the condition of the maximum efficiency of single phase transformer? [7M]

b) A 230/230 V, 3 kVA transformer gave the following results: [7M]
O.C Test: 230 V, 2 A, 100 W
S.C Test: 15 V, 13 A, 120 W
Determine the i) regulation ii) at half load 0.6p.f lag and lead efficiency at full load 0.8 p.f. lagging and leading.

OR

8 a) Derive an expression for the saving of copper in an autotransformer as compared to an equivalent two winding transformer. [7M]

b) Find the all day efficiency of a 50KVA distribution transformer having full load efficiency of 94% and full load copper loss is just equal to the constant ironloss. The loading of the transformer is as per the following schedule. [7M]
i) No load for 10 hrs. ii) Half load for 5 hrs.
iii) 25% full load for 6 hrs. iv) Full load for 3 hrs.

UNIT-V

9 a) Explain different types of 3-phase transformer connections. [7M]

b) A three phase step down transformer is connected to 6.6 kV supply mains and takes 80A. Calculate its secondary line voltage and line current for the following connections if the ratio of turns per phase is 16. (i) Y-Y (ii) Y-Δ (iii) Δ-Δ [7M]

OR

10 a) Write short notes on the tertiary windings. What are its advantages? [7M]

b) A Scott-connected transformer supplies two single phase furnaces at 100V, each taking 200kW. The load on the leading phase is at unity power factor and that on the other phase is 0.8 lagging power factors. The 3-phase input line voltage is 11000V. Calculate the line currents on the primary side. Neglect the magnetizing current and leakage impedance. [7M]

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UNIT-I

1 a) Explain the open circuit characteristics with a neat diagram and how the critical speed and critical field resistance are determined. [7M]
b) Explain V-I characteristics of a magnetic system. Also derive the expression for co-energy density. [7M]

OR

2 a) Explain the process of commutation in D.C generators. Describe the methods to improve it. [7M]
b) A 110 kW belt driven shunt generator running at 400rpm on 220V bus bars continues to run as a motor when the belt breaks. As a motor it takes 11kW. Find the speed at which it will run as a motor if the resistance of the armature and field are 0.025 Ω and 55 Ω respectively. Brush contact drop is 2V. [7M]

UNIT-II

3 a) Sketch and explain the characteristic curves of DC shunt and series motors. [7M]
b) Discuss the applications of shunt, series and compound motors. [7M]

OR

4 a) What is the necessity of starter for a motor? With a neat sketch, explain the working of a three point starter. [7M]
b) Explain constant and variable losses in DC machines. [7M]

UNIT-III

5 a) Explain different methods of speed control of dc shunt motor. [7M]
b) A 500V shunt motor takes 4A on no load. The armature resistance including that of brushes is 0.2 Ω and the field current is 1A. Estimate the output and the efficiency when the input current is i) 20A and ii) 100A. [7M]

OR

6 a) Explain retardation test on DC machines. Also state its advantages and disadvantages. [7M]
b) A transformer on no load has a core loss of 50W, draws a current of 2A (rms) and has an induced emf of 230V (rms). Determine the no load power factor, core loss current and magnetizing current. [7M]
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UNIT-IV

7 a) What is an auto transformer? Discuss the advantages and disadvantages. [7M]

b) The test results of 2.5kVA, 230/115V single-phase transformer are as follows: [7M]
OC Test : 115V, 1.2A, 60W
SC Test : 12V, 10.86A. 120W
Find i) efficiency at 50% full load, 0.8 pf
ii) regulation at 30% full load, 0.8 pf lag and lead

OR

8 a) Define voltage regulation of a transformer and derive condition for zero and maximum regulation. [7M]

b) A Transformer is rated at 100kVA. At full load its copper loss is 1200W and its iron loss is 960W. Calculate [7M]
(i) the efficiency at full load, unity power factor
(ii) the efficiency at half load, 0.8 power factor
(iii) the efficiency at 75 % full load, 0.7power factor

UNIT-V

9 a) Draw and discuss the connection diagrams of Y-Y, Δ-Δ and Y-Δ three phase transformers? [7M]

b) A 3 phase step down transformer is connected to 6600V mains and takes 10A. Calculate the secondary line voltage, line current and output for the following connections: [7M]
(i) Delta/Delta
(ii) Star/Star
(iii) Delta/Star
(iv) Star/Delta

OR

10 a) Explain the working of on-load tap changing transformer with help of neat diagram. [7M]

b) A three- winding transformer in star/delta has the following ratings: [7M]
Primary 1: 10MVA, 33kV
Secondary 2: 5MVA, 11kV
Tertiary 3: 5MVA, 3.3kV
Three short circuit tests on this transformer gave the following results:
Secondary shorted, primary excited: 3000V,160A,100kW
Tertiary shorted, primary excited: 200V, 12A, 1.25kW
Tertiary shorted, secondary excited: 100V, 40A, 1.5kW
Calculate the resistance and reactance in Ohms of the star equivalent?

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UNIT-I

1 a) Explain the phenomenon of electromechanical energy conversion. [5M]

b) A shunt generator gave the following open circuit characteristics: [9M]

Field current (A)	0.5	1	1.5	2	2.5	3	3.5
OC emf (V)	54	107	152	185	210	230	245

The armature and field resistances are 0.1Ω and 80Ω respectively. Calculate :
i) The voltage to which the machine will excite when run as a generator at the same speed.
ii) The voltage lost due to armature reaction when 100A are passing in the armature at terminal voltage of 175V.
iii) The percentage reduction in speed for the machine to fail to excite on open circuit.

OR

2 a) Derive the expression for generated EMF in DC Generator. [7M]

b) A short shunt compound generator has armature, series field and shunt field resistance of 0.06Ω, 0.03Ω and 110Ω respectively. It supplies 100 lamps rated at 250V, 40W. Find the generated EMF. Assume that contact drop per brush = 1V. [7M]

UNIT-II

3 a) Derive the torque equation for a DC motor. [7M]

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. [7M]

OR [7M]

4 a) With a neat sketch, explain the operation of 4-point starter. [7M]

b) What are the losses occur in DC Machines? Explain in detail.

UNIT-III

5 a) Explain the principle of operation of a transformer. Derive the EMF equation of a single phase transformer? [7M]

b) A 33 kVA, 2000 / 200 V, 50 Hz single phase transformer has the following parameters: [7M]
H.V side: r1 = 2 Ω; leakage reactance x1 = 6 Ω.
L.V side: r2 = 0.05 Ω; leakage reactance x2 = 0.1 Ω.
(i) Find the primary resistance and leakage reactance referred to secondary.
(ii) Find the secondary resistance and leakage reactance referred to primary.
(iii) Calculate the total ohmic losses at full load.

OR

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6 a) What is Hopkison's test and why it is called regenerative test? Draw the connection diagram to conduct their test. [7M]

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 was 5kg. The motor was running at 1300 rpm; its input being 70A at 420V dc. The pulley diameter is 1m. Determine the torque, output of the motor and efficiency of the motor. [7M]

UNIT-IV

7 a) Explain the parallel operation of the transformer with equal voltage ratios along with its equivalent circuits? [7M]

b) The efficiency of a 20kVA, 2500/250 V, single phase transformer at unity power factor is 98% at rated load and also at half rated load. Determine [7M]
(i) the transformer core loss and ohmic losses and
(ii) the p.u value of the equivalent resistance of the transformer.

OR

8 Mention the different tests that are conducted on Transformer? Explain the procedure for conducting OC and SC tests. Determine how the voltage regulation can be determined from these tests. [14M]

UNIT-V

9 a) Explain the working of off-load tap changing transformer with help of neat diagram. [7M]

b) In a scott-connection, calculate the values of the currents on the 3-phase side if the loads on the 2-phase side are 300 kW and 450 kW both at100 V and 0.707 p.f. lag and the 3-phase line voltage is 3300 V. The 300 kW load is on the leading phase on the 2-phase side. Neglecting transformer losses. [7M]

OR

10 a) Explain the effect of third harmonics in phase voltages of three phase transformers. [7M]

b) A 'Δ-Δ' bank consisting of three single phase 20KVA, 2300/230 V transformers supplies a load of 40 KVA. If one transformer is removed, find the following for the resulting V-V connection. [7M]
(i) KVA load carried by each transformer
(ii) Total KVA rating of the V-V bank
(iii) Ratio of the V-V bank to 'Δ-Δ' bank transformer ratings.