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

II B. Tech I Semester Regular/Supplementary Examinations, December-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)	Draw the diagram and explain the multi excited systems with relevant equations?	[7M]
	b)	Write in detail and explain the compound excitation in the D.C generator with necessary expressions?	[7M]

OR

2	a)	Explain the process of obtaining force by using co-energy with necessary equations?	[7M]
	b)	A compound generator has armature, series and shunt field resistances of 0.6 ohms, 0.3 ohms and 43 ohms respectively, supplies 5.7kW at 210V. Find the e.m.f generated in the armature, when it is connected as long shunt and short shunt connections?	[7M]

UNIT-II

3	a)	Consider a D.C shunt motor, derive and analyze the significance of counter e.m.f?	[7M]
	b)	A 6 pole, 220V D.C shunt motor has lap connected armature with 940 conductors. The flux per pole is 0.03wb. Find the torque developed by the armature and useful flux torque in N-m when the current taken by the motor is 33A. The armature resistance is 0.11 ohms and the field resistance is 122 ohms. The rotational losses are 211W?	[7M]

OR

4	a)	Derive the torque equation of D.C series motor and explain its staring torque.	[7M]
	b)	The 13.88kW, 210V, 1220 r.p.m 4 pole D.C shunt motor has a total of 600 conductors arranged in two parallel paths and yielding armature circuit resistance of 0.4 ohms. When it delivers rated power at rated speed, it draws a line current of 77.4A and the field current of 4.5A. Find the flux per pole, the torque developed, rotational losses and the total losses expressed as a percentage of power?	[7M]

UNIT-III

5	a)	Describe the objectives and outcomes of controlling the speed of D.C shunt motor by varying the resistance in the armature circuit? Also draw speed-torque characteristics.	[7M]
	b)	Compare the design considerations of ideal transformer and practical transformers on no-load conditions with phasor diagrams?	[7M]

OR
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6	a)	Compare and explain the constructional features of core type and shell type transformers with diagrams.	[7M]
	b)	The following results were obtained from Hopkinson's test on two similar D.C shunt machines. Supply voltage is 360V, line current is 46A, and generator armature current is 244A, field currents 2.1A for motor and 2.2A for generator. Find the efficiency of each machine on the loads of the test? The armature resistance of each machine is 0.2 ohms?	[7M]

UNIT-IV

7	a)	Derive the copper saving expression of single winding transformer? Write the advantages and applications.	[7M]
	b)	What is the regulation of a transformer? Explain the procedure to determine it.	[7M]

OR

8	a)	List out the losses in the transformer and elaborate the effect of frequency variation on the losses.	[7M]
	b)	The required no load voltage ratio in a 155kVA, 50Hz single phase transformer is 5500/220V. Calculate the efficiency at half rated kVA, unity power factor and also efficiency at full load 0.7 lagging power factor if the full load copper losses are 1750W and core losses are 1440W?	[7M]

UNIT-V

9	a)	Draw the core and winding diagram and explain the operation of 3-phase transformer. Write its applications.	[7M]
	b)	A 3-phase transformer is used to step down the voltage of a 3 phase, 3300kV feeder line. Per phase turns ratio is 14. For a primary line current of 17A, find the secondary line voltage, line current and kVA for the star-delta and delta-star connections by neglecting the losses?	[7M]

OR

10	a)	Draw the circuit and phasor diagram of 3-phase transformer used at the beginning of the transmission.	[7M]
	b)	Describe the existence of third harmonics in the 3-phase transformer operation with relevant waveforms.	[7M]

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UNIT-I

1	a)	Discuss the principles of electro mechanical energy conversion through magnetic field?	[7M]
	b)	Obtain and analyze the open circuit characteristics, internal and external characteristics of D.C series generator with relevant relations?	[7M]

OR

2	a)	Explain the process of obtaining torque by using co-energy with necessary equations?	[7M]
	b)	A short shunt compound generator supplies a load current of 96A at 240V. The generator has shunt field resistance of 122 ohms, armature resistance of 0.4 ohms and series field resistance of 0.4 ohms. Determine the e.m.f generated if the brush drop is 1.2V per brush?	[7M]

UNIT-II

3	a)	What is the significance of starter in DC motor? With a neat diagram, describe the operation of 3-point starter.	[7M]
	b)	A 72kW, 514V, D.C shunt motor has 4 poles and wave connected armature winding with 496 conductors. The flux per pole is 0.05wb and the full load efficiency is 0.88. The armature and commutating pole windings have a total resistance of 0.07 ohms and shunt field resistance is 202 ohms. Find for full load the speed, useful torque delivered to the load and the torque developed?	[7M]

OR

4	a)	Draw and compare the speed-armature current characteristics of different D.C motors?	[7M]
	b)	A 66kW, 410V D.C shunt motor has 4 poles and a wave connected armature of 440 conductors. The flux per pole is 44 mwb. Armature resistance is 0.3 ohms and shunt resistance is 213 ohms, If the full load efficiency is 89.6%, calculate the speed, armature torque and useful torques?	[7M]

UNIT-III

5	a)	Describe the objectives and outcomes of controlling the speed of D.C shunt motor by varying the resistance in the excitation circuit? Also draw speed-torque characteristics?	[7M]
	b)	Compare the on-load and no-load conditions of ideal transformer with phasor diagrams?	[7M]

OR

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6 a) Describe the parameters of a practical transformer with open circuit diagram and phasor diagram. [7M]

b) The Hopkinson's test on two identical shunt machines gave the following results. Line voltage is 200V, line current excluding field current is 41A, motor armature current is 318A, generator and motor field currents are 5.1A and 4.4A respectively. The armature resistance of each machine is 0.033 ohms. Find the efficiency of each machine at this load condition? [7M]

UNIT-IV

7 a) Draw the winding diagram and explain the characteristic features of variable transformer with disadvantages. [7M]

b) With neat circuit, explain the procedure to conduct sumpner's test on a transformer. What are the advantages of it as compared with its counter parts? [7M]

OR

8 a) List out the losses in the transformer and elaborate the effect of supply voltage variation on the losses. [7M]

b) An 112kVA, 1100/11kV, 50Hz single phase transformer has an iron loss of 1060W. The copper loss with 5.4A in the high voltage winding is 412W. Find the efficiencies at $1/4^{th}$, 1/2 and full load of normal load for power factor of 0.9 and 0.7? The output terminal voltage being maintained at 12kV. Calculate the also the load for maximum efficiency at both the power factors? [7M]

UNIT-V

9 a) Derive the phase voltage expression of 3 phase transformer connected in star-star with circuit diagram and phasor diagrams. [7M]

b) A 3 phase transformer is used to step down the voltage of a 3 phase, 3300kV feeder line. Per phase turns ratio is 14. For a primary line current of 17A, find the secondary line voltage, line current and kVA for the delta-delta and star-star connections by neglecting the losses? [7M]

OR

10 a) Compare the delta-delta connection of 3 phase transformer with open delta connection. [7M]

b) Discuss in detail about the operation, advantages and disadvantages of ON Load tap changers. [7M]

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UNIT-I

1	a)	Draw the diagram and explain the energy conversion by using a coil attracted by armature relay coil.	[7M]
	b)	Obtain and analyze the open circuit characteristics, internal and external characteristics of D.C shunt generator with relevant relations.	[7M]

OR

2	a)	Explain the field energy and co-energy by using current verses total flux characteristics.	[7M]
	b)	The 8 pole D.C shunt generator with 880 wave connected conductors and running at 650 r.p.m supplies a load of 16.8 ohms resistance at a terminal voltage of 220V. The armature resistance is 0.22 ohms and field resistance is 219 ohms. Find the armature current, the induced e.m.f and flux per pole?	[7M]

UNIT-II

3	a)	Draw the winding diagram and explain the operation of differential compound motor with necessary equations.	[7M]
	b)	Draw and discuss in detail about the power flow diagram of D.C motor.	[7M]

OR

4	a)	Derive and explain in detail about the armature torque and shaft torques of D.C shunt motors.	[7M]
	b)	A 5.7kW, 210V D.C shunt motor has an armature resistance of 0.8 ohms and shunt field resistance of 92 ohms. At no-load the motor draws 5.8A from a 180V supply and runs at 900 r.p.m. Find the rotational losses and no load torque of the machine?	[7M]

UNIT-III

5	a)	Describe how the ward-loenard system provides the constant torque and constant power drive with circuit and characteristics.	[7M]
	b)	Draw the circuit diagram and explain the operation of practical transformer with unity power factor load connected on the secondary side.	[7M]

OR

6	a)	Derive and analyze the required conditions to derive the transformer equivalent circuit referred to the primary side.	[7M]
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b) A 212V, D.C shunt motor with an armature resistance of 0.4 ohms and shunt field resistance of 220 ohms drives a load, the torque of which remains constant. The motor speed is 660 r.p.m when the armature current is 22A. If the speed is to be raised to 820 r.p.m, find the change must be effected in the shunt field resistance? Assume the magnetization curve of the motor is a straight line? [7M]

UNIT-IV

7 a) An auto transformer is used to transform from 410V to 312V. The load is 11kW at unity power factor. By neglecting the losses and magnetization current, calculate the currents in various parts of the winding? [7M]

b) Describe the role of variable prime mover in the separation of hysteresis and eddy current losses of transformer with circuit diagram. [7M]

OR

8 a) Compare the objectives and outcomes of no-load and full load tests on the transformer. [7M]

b) A 5.6kVA distribution transformer has a full load efficiency of 94% at which copper loss is equal to the iron loss. The transformer is loaded in 24 hours as follows: No load for 8 hours, $1/4^{th}$ load for 9 hours, half load for 4 hours and full load 3 hours. Find the all day efficiency of the transformer? [7M]

UNIT-V

9 a) Explain the 3 phase transformer connection when the service continuity is mandatorily maintained. [7M]

b) Describe the effect of transients in switching on the operation of three phase transformer. [7M]

OR

10 a) Draw the connection diagram and explain the outcomes of Scott connection of three phase transformers. [7M]

b) A 3 phase transformer is used to step down the voltage of a 3 phase, 33kV feeder line. Per phase turns ratio is 10. For a primary line current of 24A, find the secondary line voltage, line current and output kVA for star-delta and star-star connections. [7M]

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UNIT-I

1 a) Discuss the principles of electro mechanical energy conversion through electric field? [7M]

b) Derive and explain flat, over and under compound generator characteristics with relevant expressions? [7M]

OR

2 a) Draw and explain the singly excited system with circuit diagram and necessary equations? [7M]

b) A compound generator delivers a load current of 52A at 492V. The resistance of the armature is 0.06 ohms, series field is 0.07 ohms and shunt field is 217 ohms. Calculate the induced e.m.f if contact drop is 1.4V per brush. Neglect the armature reaction. Assume long shunt and short shunt connections? [7M]

UNIT-II

3 a) Draw the winding diagram and explain the operation of cumulative compound motor with necessary equations? [7M]

b) Draw the diagram and explain the operation of four point starter used for D.C motors? [7M]

OR

4 a) Draw and compare the torque-armature current characteristics of different D.C motors? [7M]

b) A 4 pole 210V lap wound D.C shunt motor has 920 conductors. The flux per pole is 32mwb. Find the torque developed by the armature and the useful torque in N-m when the current drawn by the motor is 26A. The armature resistance is 0.2 ohms and the shunt field resistance is 124 ohms. The rotational loss of the machine is 818W? [7M]

UNIT-III

5 a) Draw the circuit diagram and estimate the outcomes of back to back test on the D.C machines? [7M]

b) A 3300/400V single phase 612kVA transformer has 1100 primary turns. Calculate the transformation ratio, secondary turns, voltage per turn, secondary current when it supplies a load of 416kW at 0.9 power factor lagging? [7M]

OR

6 a) Derive and analyze the required conditions to derive the transformer equivalent circuit referred to the secondary side? [7M]
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b) The results of Hopkinson's test conducted on a pair of D.C shunt machine at full load are as follows: Line voltage is 226V, line current is 51A, and motor armature current is 192A. generator field current is 6.4A and motor field current is 5.6A, armature resistance is 0.04 ohms for both machines. Find the efficiency of each machine? [7M]

UNIT-IV

7 a) The primary and secondary voltages of an auto transformer are 200V and 154V respectively. Find the current in the differential parts of the winding when the load current is 107A? Also find the percentage saving in the copper material? [7M]

b) Derive and analyze the output quantities of transformer from the short circuit test with diagram? [7M]

OR

8 a) Why the meters are connected at LV side by opening the HV side of transformer to conducting no load test? Justify the answer and draw the corresponding equivalent circuit. [7M]

b) Describe the outcomes of parallel operation of transformers having equal voltage ratios with circuit diagrams? [7M]

UNIT-V

9 a) Draw the connection diagram of three phase transformer used at the distribution side with connection and phasor diagrams? [7M]

b) By drawing neat diagram explain the operation of No-load tap changer? Also write its drawbacks? [7M]

OR

10 a) Explain the connection diagram and write the design features of T-T connection of three phase transformer? [7M]

b) A 3 phase transformer is used to step down the voltage of a 3 phase, 33kV feeder line. Per phase turns ratio is 10. For a primary line current of 24A, find the secondary line voltage, line current and output kVA for delta-star and delta-delta connections? [7M]