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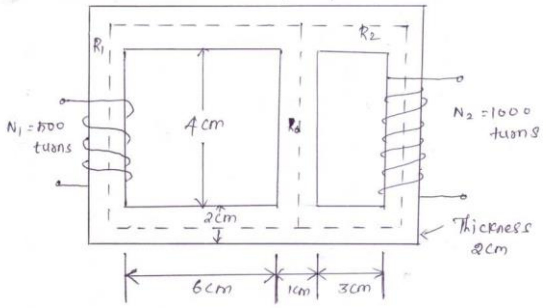
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

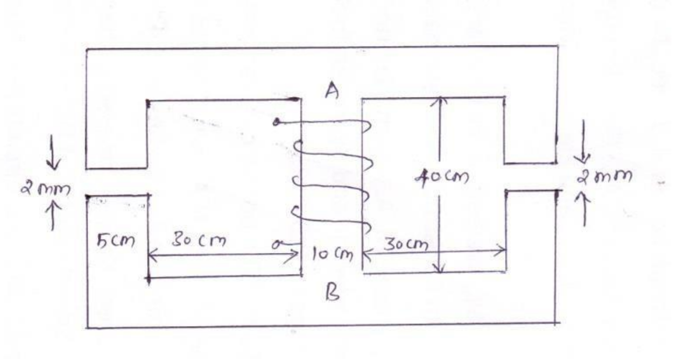
QUESTION BANK

SUBJECT: EE3303 – ELECTRICAL MACHINES-I

SEM / YEAR: III SEMESTER/II YEAR

UNIT I MAGNETIC CIRCUITS AND MAGNETIC MATERIALS				
Magnetic circuits –Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically and Dynamically induced EMF - Torque – Properties of magnetic materials, Hysteresis and Eddy Current losses - AC excitation, introduction to permanent magnets-Transformer as a magnetically coupled circuit				
PART – A				
Q. No	**Questions**	**BTL**	**Competence**	**Course Outcome**
1.	Explain Statically induced EMF?	BTL5	Evaluate	CO 1
2.	Prepare the list of the materials suitable for fabrication of Permanent Magnets.	BTL6	Create	CO 1
3.	What is the important property of deltamax cores?	BTL3	Apply	CO 1
4.	What are the types of magnetic losses?	BTL1	Remember	CO 1
5.	Define magnetic flux density.	BTL1	Remember	CO 1
6.	A coil of 1500 turns carrying a currnt of 5 Amps produces a flux of 2.5mWb. Calculate the self-inductance of the coil.	BTL3	Apply	CO 1
7.	Define magnetic reluctance.	BTL1	Remember	CO 1
8.	Distinguish statically and dynamically induced EMF.	BTL2	Understand	CO 1
9.	Give the expressions for Hysteresis losses and Eddy current losses and illustrate the various ways to minimize them.	BTL3	Apply	CO 1
10.	Define reluctance and permeance.	BTL1	Remember	CO 1
11.	Define Relative Permeability.	BTL2	Understand	CO 1
12.	Define (i) Ampere's Law (ii) Inductance.	BTL1	Remember	CO 1
13.	Differentiate leakage flux and mutual flux?	BTL2	Understand	CO 1
14.	Define Self Inductance.	BTL2	Understand	CO 1
15.	What are the core losses and how can this loss be minimized? Justify.	BTL5	Evaluate	CO 1
16.	Infer fringing effect in a magnetic circuit?	BTL4	Analyze	CO 1
17.	Discuss in brief the stacking factor.	BTL3	Apply	CO 1
18.	Draw and explain the magnetization curve of ferromagnetic material.	BTL4	Analyze	CO 1
19.	Compare electric and magnetic circuits.	BTL4	Analyze	CO 1
20.	Formulate the coefficient of coupling?	BTL6	Create	CO 1
PART – B				

1.	For the magnetic circuit as shown below, Calculate the self and mutual inductance between the two coils. Assume core permeability =1600. (13) 	BTL3	Apply	CO 1
2.	Draw and explain the typical magnetic circuit with air-gap and its equivalent electric circuit. Hence derive the expression for air gap flux. (13)	BTL4	Analyze	CO 1
3.	Examine the property of Magnetic Materials (i) Para Magnetic (ii) Dia Magnetic Materials (iii) Ferro Magnetic Materials. (13)	BTL3	Apply	CO 1
4.	Explain the following Magnetic field properties (i) Magnetic Field (ii) Magnetic Flux (iii) Magnetic Flux Density (iv)Magnetic Intensity or Force (v)Absolute and Relative Permeability. (13)	BTL4	Analyze	CO 1
5.	An iron rod 1.8 cm diameter is bent to form a ring of mean diameter 25 cm and wound with 250 turns of wire. A gap of 1mm exists in between the end faces. Calculate the current required to produce a flux of 0.6 mWb. Take relative permeability of iron as 1200. (13)	BTL4	Analyze	CO 1
6.	(i) Specify the causes for Hysteresis and Eddy current losses in Electrical machines. Also give the methods in construction to minimize the above losses. (6)	BTL1	Remember	CO 1
	(ii) List the properties of magnetic material suitable for fabrication Permanent Magnet and Electromagnet. (7)	BTL1	Remember	CO 1
7.	(i) Describe the AC operation of magnetic circuits. (6)	BTL1	Remember	CO 1
	(ii) Describe the principle of a typical magnetic circuit with airgap and explain. Also show that the core reluctance may be neglected in practice. (7)	BTL1	Remember	CO 1
8.	The magnetic circuit has dimensions: A_c=4*4 cm^2, I_g=0.06 cm, I_c =40 cm and N=600 turns. Assume the value of μ_r=6000 for iron. Measure the exciting current for B_c =1.2 T and the Corresponding flux and flux linkages. (13)	BTL 6	Create	CO 1
9.	(i) Describe the methods of analyzing the magnetic circuits. (6)	BTL1	Remember	CO 1
	(ii) Examine the typical B-H Curve and hysteresis loops and explain its Concept. (7)			
10.	(i) Extend the expression for self and mutual inductance of the coil. (6)	BTL2	Understand	CO 1
	(ii) Two coils A and B are wound on same iron core. There are 600 turns on A and 3600 turns on B. The			

	current of 4A flows through coil. A produces a flux of $500*10^{-6}$ Wb in the core. If this current is reversed in 0.02 sec., Identify the average emf induced in coils A and B. (7)			
11.	For the magnetic circuit shown in fig with a core thickness of 5cm, exciting current of 0.5A wound with 1000turns coil, find the flux density and flux in each of the outer limbs and the central limbs. Assume relative permeability for iron of the core to be a) infinity b) 4500. (13)  	BTL2	Understand	CO 1
12.	(i) Give the expression for energy density in the magnetic field.(3)	BTL2	Understand	CO 1
	(ii) Describe in detail "Eddy-current loss". (3)	BTL2	Understand	CO 1
	(iii) The total core loss of a specimen of silicon steel is found to be 1500W at 50Hz. Keeping the flux density constant the loss becomes 3000 W when the frequency is raised to75 Hz. Calculate separately the hysteresis and eddy current loss at each of their frequencies. (7)	BTL2	Understand	CO 1
13.	A ring has a diameter of 24cm and a cross sectional area of 1000 mm^2 . the ring is made up of semicircular section of cast iron and cast steel with each joint having a reluctance equal to an air-gap of 0.2 mm. Find the ampere turns required to produce a flux of 8×10^{-4} Wb. The relative permeability of cast steel and cast iron are 900 and 170 respectively. Neglect fringing and leakage effects.(13)	BTL5	Evaluate	CO 1
14.	A square wave voltage of amplitude E = 100 V and frequency 60 Hz is applied on a coil wound on a closed iron core. The coil has 500 turns, and the cross sectional area of the core is $0.001m^2$, Assume that the coil has no resistance. (i) Find the maximum value of the flux and sketch the waveforms of voltage and flux as a function of time.(6) (ii) Find the maximum value of E if the maximum flux density is not to exceed 1.2 tesla. (7)	BTL5	Evaluate	CO 1
	PART – C			
1.	(i) Compare the difference between electric circuit and magnetic circuit. (7) (ii)What is meant by induced emf? Explain the following types of induced emf (a) Statically Induced	BTL4	Analyze	CO 1

	emf. (b) Dynamically Induced emf. (8)			
2.	An electromagnetic relay has an exciting coil of 800 turns. The coil has a cross section of 5 cm × 5 cm. Find (a) coil inductance if the air gap length is 0.5 cm. (b) field energy stored for a coil current of 1.25 A (c) Permeance at the air gap. (15)	BTL 5	Evaluate	CO 1
3.	Explain the following Magnetic field properties (i) Magnetic Field (ii) Magnetic Flux (iii) Magnetic Flux Density (iv) Magnetic Intensity or Force (v) Absolute and Relative Permeability (vi) Reluctance (vii) Permeance (viii)Magneto Motive Force. (15)	BTL4	Analyze	CO 1
4.	A toroidal core made of mild steel has a mean diameter of 16cm and a cross-sectional area of $3cm^2$. Calculate a) the m.m.f to produce a flux of $4 X 10^{-4}$ Wb and b) the corresponding values of the reluctance of the core and the relative permeability. (15)	BTL4	Analyze	CO 1

UNIT II
TRANSFORMERS

Construction – principle of operation – equivalent circuit parameters – phasor diagrams, losses – testing – efficiency and voltage regulation - all day efficiency - Sumpner's test, per unit representation – inrush current - three phase transformers-connections – Scott Connection – Phasing of transformer – parallel operation of three phase transformers - auto transformer – tap changing transformers - tertiary winding.

PART - A

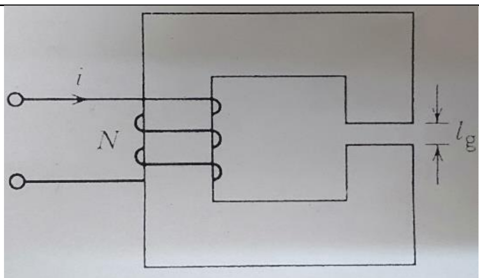
Q.No.	Questions	BTL	Competence	Course Outcome
1.	List out the merits and demerits of core and shell type transformer.	BTL5	Evaluate	CO 2
2.	How do you reduce leakage flux in a transformer?	BTL2	Understand	CO 2
3.	What is the condition for maximum efficiency of transformer?	BTL4	Analyze	CO 2
4.	What happens if DC supply is applied to the transformer?	BTL3	Apply	CO 2
5.	Give the principle of transformer.	BTL2	Understand	CO 2
6.	List the losses in a transformer?	BTL1	Remember	CO 2
7.	The emf per turn for a single-phase 2200/220 V, 50 Hz transformer is 11 V. Calculate the number of primary and secondary turns.	BTL3	Apply	CO 2
8.	Describe turns ratio of transformer.	BTL4	Analyze	CO 2
9.	Why is transformer rated in KVA?Justify	BTL1	Remember	CO 2
10.	Explain ideal transformer and draw its phasor diagram?	BTL1	Remember	CO 2
11.	Compose the advantages and applications of auto transformer.	BTL1	Remember	CO 2
12.	Differentiate twowinding transformer and auto transformer.	BTL1	Remember	CO 2
13.	Full load copper loss in a transformer is 1600 W, What will be the loss at half load?	BTL1	Remember	CO 2

14.	Deduce the voltage regulation of a transformer.	BTL5	Evaluate	CO 2
15.	Predict the causes of stray losses.	BTL2	Understand	CO 2
16.	Show the condition for parallel operation of a transformer?	BTL2	Understand	CO 2
17.	Compose the purpose of conducting open circuit test.	BTL6	Create	CO 2
18.	Describe the role of tertiary winding in Transformer.	BTL4	Analyze	CO 2
19.	Define all day efficiency. Explain why all day efficiency is lower than commercial efficiency.	BTL2	Understand	CO 2
20.	Interpret the Inrush current in a transformer	BTL6	Create	CO 2
PART - B				
1.	Explain the construction, working principle and operation of a transformer. Derive its emf equation.(13)	BTL4	Analyze	CO 2
2.	The voltage per turn of a single phase transformer is 1.1 volt, when the primary winding is connected to a 220 volt, 50 Hz AC supply the secondary voltage is found to be 550 volt. Identify the primary and secondary turns and core area if maximum flux density is 1.1 Tesla. (13)	BTL5	Evaluate	CO 2
3.	Calculate the efficiency for half, full load of a 100KVA transformer for the P.F of unity and 0.8, the copper loss at full load is 1000W and iron loss is 1000W. (13)	BTL3	Apply	CO 2
4.	Develop the equivalent circuit of a single phase transformer referred to primary and secondary. (13)	BTL6	Create	CO 2
5.	Draw and explain the phasor diagram of transformer when it is operating under load. (13)	BTL3	Apply	CO 2
6.	(i) The emf per turn of a single phase, 6.6 kV/440 V, 50 Hz transformer is approximately 10V. Calculate the number of turns in the HV and LV windings and the net cross sectional area of the core for a maximum flux density of 1.6 T. (7)	BTL1	Remember	CO 2
	(ii) A 500 KVA Transformer has a core loss of 2200 watts and a full load copper loss of 7500 watts. If the power factor of the load is 0.90 lagging, Evaluate the full load efficiency and the KVA load at which maximum efficiency occurs. (6)	BTL 5	Evaluate	CO 2
7.	(i)A 11000/230 V, 150 kVA, 1-phase, 50 Hz transformer has loss of 1.4 kW and Full Load copper loss of 1.6 kW. Determine (i) the kVA load for maximum efficiency and the value of maximum efficiency at unity p.f. (ii) The efficiency at 0.8 pf leading. (6)	BTL2	Understand	CO 2
	(ii) A 500KVA transformer has 95% efficiency at full load and also at 60% of full load both at UPF. a)Separate out the transformer losses.(6) b)Measure the transformer efficiency 75% full load, UPF. (7)	BTL2	Understand	CO 2

8.	(i) Obtain the generalized conditions for parallel operation of Transformer. Also explain the effect of load sharing due to impedance variation between transformers during parallel operation. (7)	BTL6	Create	CO 2
	(ii) A 100 KVA, 3300 V/240 V, 50 HZ single phase transformer has 990 turns on the primary. Identify the number of turns on secondary and the approximate value of primary and secondary full load currents. (6)	BTL1	Remember	CO 2
9.	A single phase transformer has 180 turns respectively in its secondary and primary windings. The respective resistances are 0.233 and 0.067. Calculate the equivalent resistance of a) the primary in terms of the secondary winding b) the secondary in terms of the primary winding c) the total resistance of the transformer in terms of the primary.(13)	BTL1	Remember	CO 2
10.	Explain the back to back method of testing for two identical single phase transformers. (13)	BTL2	Understand	CO 2
11.	Obtain the equivalent circuit of a 200/400V 50 Hz single phase transformer from the following test data. O.C.test: 200V, 0.7A, 70W – on L .V Side S.C. test: 15V, 10A, 85W – on H.V side Calculate the secondary voltage when delivering 5 kW at 0.8 p.f. lagging. The primary voltage being 200V.(13)	BTL4	Analyze	CO 2
12.	Describe the various three phase transformer connection and parallel operation of three phase transformer. (13)	BTL1	Remember	CO 2
13.	Describe the method of calculating the regulation and efficiency of a single phase transformer by OC and SC tests? (13)	BTL1	Remember	CO 2
14.	i) Interpret in detail about the autotransformer, their principle. Arrive at the expression for saving of copper.(10)	BTL4	Analyze	CO 2
	ii) Evaluate in brief the voltage regulation with necessary expressions. (5)	BTL4	Analyze	CO 2
	PART - C			
1.	Obtain the equivalent circuit of a 200/400V 50 Hz single phase transformer from the following test data. O.C.test: 1100V, 0.5A, 55W – on primary Side, secondary being open circuited S.C. test: 10V, 80A, 400 W – on LV side, high voltage side being short circuited. Calculate the voltage regulation and efficiency for the above transformer when supplying 100A at 0.8 p.f. lagging. (15)	BTL 4	Analyze	CO 2
2.	A single phase transformer has $Z_1 = 1.4 + j5.2\Omega$ and $Z_2 = 0.0117 + j0.465\Omega$. The input voltage is 6600 V and the turn ratio is 10.6: 1. The secondary feeds a load which draws 300 A at 0.8 power factor lagging. Find the secondary terminal voltage and the KW output. Neglect no-load current.	BTL 4	Analyze	CO 2

3.	The primary of the transformer is rated at 10A and 1000V. The open circuit reading are V_1=1000V, V_2=500V, I=.42A, P_{ac}=100W.The short circuit readings are I_1=10A,V_1=125V and P_{ac}=400W. Draw the equivalent circuit for the transformer. Predict the output voltage for the load impedance Z_L=19+j12ohms and draw the phasor diagram. (15)	BTL 5	Create	CO 2
4.	A transformer with normal voltage impressed has a flux density of 1.2 T and core loss comprising 1200 W eddy current loss and 3500 W hysteresis loss. What do these losses become under the following conditions: (i)Increasing the applied voltage by 5% at rated frequency.(5) (ii)Reducing the frequency by 5% with normal voltage impressed.(5) (iii)Increasing both impressed voltage and frequency by 5%. (5)	BTL 5	Create	CO 2
UNIT III ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES				
Energy in magnetic system – Field energy and coenergy - force and torque equations – singly and multiply excited magnetic field systems - mmf of distributed windings – Winding Inductances - magnetic fields in rotating machines – rotating mmf waves – magnetic saturation and leakage fluxes.				
PART - A				
Q.No.	**Questions**	**BTL**	**Competence**	**Course Outcome**
1.	Describe co energy?	BTL2	Understand	CO 3
2.	Why do all practical energy conversion devices make use of the magnetic field as a coupling medium rather than an electric field? Explain.	BTL4	Analyze	CO 3
3.	Compose the advantages of analyzing energy conversion devices by field energy concept.	BTL4	Analyze	CO 3
4.	Give example for continuous energy conversion equipment and force producing devices.	BTL2	Understand	CO 3
5.	Formulate synchronous speed. Write the expression also.	BTL6	Create	CO 3
6.	Differentiate the pitch factor and distribution factor.	BTL2	Understand	CO 3
7.	Generalize example for singly and multiply excitation systems.	BTL6	Create	CO 3
8.	Explain reactance voltage.	BTL4	Analyze	CO 3
9.	List the basic requirements of the excitation systems?	BTL1	Remember	CO 3
10.	Tell why fractional pitched winding is preferred over full.	BTL1	Remember	CO 3
11.	Why the relationship between current and coil flux linkages of electromechanical energy conversion devices are linear?	BTL1	Remember	CO 3
12.	Show the equation, which relates rotor speed in electrical and mechanical radian/second.	BTL1	Remember	CO 3
13.	State the principle of conservation of energy.	BTL3	Apply	CO 3

14.	Define winding factor?	BTL1	Remember	CO 3
15.	In a linear system Show that field energy and co energy are equal.	BTL3	Apply	CO 3
16.	What are the cusses for irrecoverable energy loss when the flux in the magnetic circuits undergoes a cycle?	BTL2	Understand	CO 3
17.	Deduce the assumptions made to determine the distribution of coil mmf.	BTL5	Evaluate	CO 3
18.	Define the term pole pitch and coil pitch.	BTL1	Remember	CO 3
19.	Why synchronous machine does not produce torque at any other speed? Justify.	BTL5	Evaluate	CO 3
20.	Describe SPP? What is its significance?	BTL2	Understand	CO 3
PART - B				
1.	Two coupled coils have self and mutual inductance of L_{11} = 3+0.5x ; L_{22} = 2+0.5x ; L_{12} = L_{21} = 0.3x over a certain range of linear displacement x. the first coil is excited by a constant current of 15 A and the second by a constant current of -8 A. Determine, (i) Mechanical work done if x changes from 0.6m to 1m. (ii) Energy supplied by each electrical source. (13)	BTL1	Remember	CO 3
2.	Formulate the torque equation of a round rotor machine. Also clearly state the assumptions made. (13)	BTL6	Create	CO 3
3.	Consider an attracted armature relay is excited by an electric source. Explain about the mechanical force developed and the mechanical energy output with necessary equation for linear and nonlinear cases. (13)	BTL2	Understand	CO 3
4.	Explain briefly the production of rotating magnetic field. What are the speed and direction of rotation of the field? Is the speed uniform? (13)	BTL4	Analyze	CO 3
5.	(i) Describe the concept of rotating MMF waves in AC Machine. (6)	BTL1	Remember	CO 3
	(ii) Obtain an expression for the mechanical force of field origin in a typical Attracted armature relay. (7)	BTL2	Understand	CO 3
6.	Derive the field energy, co-energy and force for a doubly excited systems.(5+5+3)	BTL2	Understand	CO 3
7.	The magnetic system shown in figure 1 has the following parameters: N = 500 I = 2 A Width of air gap = 2.0 cm Depth of air gap = 2.0 cm Length of air gap = 1mm Neglect the reluctance of the core, the leakage flux, and the fringing flux. (i) Determine the force of attraction between both sides of the air gap.(6) (ii) Determine the energy stored in the air gap.(7)	BTL3	Apply	CO 3

	 Figure. 1			
8.	(i) Describe the torque in doubly excited magnetic system and show that is equal to the rate of increase of field energy with respect to displacement at constant current. (6)	BTL2	Understand	CO 3
	(ii) The λ-I characteristics of singly excited electromagnet is given by **$i = 121\lambda^2 x^2$** for **$0<i<4$ A** and **$0<x<10$Cm**. If the air gap is 5cm and a current of 3A is Flowing in the coil, Identify (a) Field Energy (b) Co-energy (c) Mechanical Force on the moving part. (7)	BTL1	Remember	CO 3
9.	Describe the m.m.f space wave of one phase of distributed a.c. winding. (13)	BTL1	Remember	CO 3
10.	(i) Describe the flow of energy in electromechanical devices. (4)	BTL1	Remember	CO 3
	(ii) Describe about the 'field energy' and 'co energy' in magnetic system.(4)	BTL1	Remember	CO 3
	(iii) The magnetic flux density on the surface of an iron face is 1.6 T which is a typical saturation level value for ferromagnetic material. Identify the force density on the iron face. (5)	BTL1	Remember	CO 3
11.	Derive an expression for the magnetic energy stored in a singly excited electromagnetic relay. (13)	BTL4	Analyze	CO 3
12.	Evaluate an expression for co-energy density of an electromechanical energy conversion device. (13)	BTL5	Evaluate	CO 3
13.	Two windings, one mounted in stator and other at rotor have self and mutual inductance of L_{11} =4.5 and L_{22} =2.5, L_{12} =2.8cosθ where θ is the angle between axes of winding. Winding2 is short circuited and current in winding as a function of time is i_1 = 10 sinωt A. Infer the expression for numerical value in Newton-meter for the instantaneous value of torque in terms of θ. (13)	BTL4	Analyze	CO 3
14.	In an electromagnetic relay, functional relation between the current i in the excitation coil, the position of armature is x and the flux linkage Ψ is given by $i = 2\Psi^3 + 3(1-x+x^2)$, x>0.5. Examine the force on the armature as a function of Ψ. (13)	BTL3	Apply	CO 3
	PART - C			
1.	The doubly-excited magnetic field has coil self and mutual inductances of $L_{11}=L_{22}=2$ $L_{12}=L_{21}=\cos\theta$	BTL6	Create	CO 3

	Where θ is the angle between the axes of the coils. The coils are connected in parallel to a voltage source $V=V_m\sin\omega t$. Derive an expression for the instantaneous torque as a function of the angular position θ. Find the time-average torque. Evaluate for θ=30deg, γ=100sin314t.(15)			
2.	(i) Explain the concepts of rotating MMF waves in AC Machines. (7)	BTL5	Evaluate	CO 3
	(ii) The magnetic flux density on the surface of an iron faces is 1.8T which is a typical saturation level value for ferromagnetic material. Identify the force density on the iron face.(8)	BTL5	Evaluate	CO 3
3.	With neat sketch explain multiple excited magnetic field system in electromechanical energy conversion systems. Also obtain the expression for field energy in the system.(15)	BTL4	Analyze	CO 3
4.	Explain in detailed MMF distribution in AC synchronous machine and derive the expression for fundamental MMF. (15)	BTL5	Evaluate	CO 3

UNIT IV DC GENERATORS

Construction and components of DC Machine – Principle of operation - Lap and wave windings - EMF equations – circuit model – armature reaction – methods of excitation -commutation and inter poles -Compensating winding – characteristics of DC generators.

PART - A

Q.No.	Questions	BTL	Competence	Course Outcome
1.	List the factors involved in the voltage buildup of a Shunt Generator.	BTL1	Remember	CO 4
2.	Why the armature core in a DC machine is constructed with laminated steel sheets instead of solid steel sheets?	BTL1	Remember	CO 4
3.	Define residual EMF in DC Generator?	BTL1	Remember	CO 4
4.	Define back pitch and front pitch.	BTL1	Remember	CO 4
5.	Define winding pitch and commutator pitch.	BTL1	Remember	CO 4
6.	Define Commutation and Commutation period.	BTL1	Remember	CO 4
7.	Differentiate Lap winding and Wave Winding of a DC machine armature.	BTL2	Understand	CO 4
8.	Discuss why the external characteristics of a DC Shunt Generator is more drooping than that of a separately excited.	BTL2	Understand	CO 4
9.	Discuss the detail under which conditions a dc shunt generator fails to excite.	BTL2	Understand	CO 4
10.	Discuss the purpose of yoke in dc machine.	BTL2	Understand	CO 4
11.	Classify the different types of DC Generators based on method of excitation?	BTL3	Apply	CO 4
12.	Demonstrate the armature reaction in DC Generators? What are its effects?	BTL3	Apply	CO 4

13.	Why load voltage across DC shunt generator is decreasing with increase in load current?	BTL3	Apply	CO 4
14.	Explain in short the role of inter poles in DC Machines.	BTL4	Analyze	CO 4
15.	Point out why the air gap between the pole pieces and the armature is kept very small?	BTL4	Analyze	CO 4
16.	What are the methods to improve commutation?	BTL4	Analyze	CO 4
17.	Integrate the Characteristics of all DC Generators in single graph.	BTL5	Evaluate	CO 4
18.	Summarize the application of various types of Generators.	BTL5	Evaluate	CO 4
19.	Generalize the requirements of the excitation systems?	BTL6	Create	CO 4
20.	Develop critical resistance of a dc shunt generator.	BTL6	Create	CO 4
	PART - B			
1.	(i) Draw and Explain the Internal and External Characteristics of different types of DC Generators. (6)	BTL1	Remember	CO 4
	(ii) A 4 pole DC Shunt Generator with lap connected armature supplies 5 kilowatt at 230 Volts. The armature and field copper losses are 360 Watts and 200 Watts respectively. Calculate the armature current and generated EMF? (7)	BTL1	Remember	CO 4
2.	A separately excited generator when running at 1200rpm supplies 200A at 125V to a circuit of constant resistance. What will be the current when the speed dropped to 1000rpm and field current is reduced to 80%. Given that armature resistance=0.4Ω and the total drop at brushes =2V. Ignore the saturation and armature reaction. (13)	BTL6	Create	CO 4
3.	In a 400 volts, DC Compound Generator, the resistance of the armature, series and shunt windings are 10 ohm, 0.05 ohm and 100 ohms respectively. The machine supplies power to 20 Nos. resistive heaters, each rated 500 watts, 400 volts. Identify the induced emf and armature currents when the generator is connected in (1) Short Shunt (2) Long Shunt. Allow brush contact drop of 2 volts per brush.(13)	BTL2	Understand	CO 4
4.	(i) Explain the armature reaction and commutation in detail for a DC Machine. (6)	BTL4	Analyze	CO 4
	(ii) A 4 pole 50 kW 250 V wave wound shunt generator has 400 armature conductors. Brushes are given a lead of 4 commutator segments. Calculate the demagnetization ampere-turns per pole if shunt field resistance is 50Ω. Also calculate extra shunt field turns per pole to neutralize the demagnetization. (7)	BTL4	Analyze	CO 4
5.	A 4 pole DC shunt generator, with a shunt field resistance of 100 ohms and an armature resistance of 1 ohm, has 378 wave connected conductors in its armature. The flux per pole is 0.02 Wb. If a load	BTL2	Understand	CO 4

	resistance of 10 ohm is connected across the armature terminals and the generator is driven at 1000 rpm. Calculate the power absorbed by the load.			
6.	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 15 A. Calculate the current per conductor and the drop in armature for Lap and Wave winding connections. (13)	BTL3	Apply	CO 4
7.	(i) Show the condition for maximum efficiency of the DC Generator. (7)	BTL2	Understand	CO 4
	(ii)Explain the following: (a) Self and separately excited DC generators(3) (b) Commutation.(3)	BTL1	Remember	CO 4
8.	(i) Calculate the emf induced in the armature of a two pole generator whose armature has 280 conductors and is revolving at 1000 rpm. The flux per pole is 0.03 Weber. (6)	BTL1	Remember	CO 4
	(ii) Calculate the generated emf of a DC Generator which has 4 poles total number of conductors equal to 256 Lap wound running at 2000 rpm. The useful flux per pole is 0.2 Weber. (7)	BTL1	Remember	CO 4
9.	Explain in detail about commutation and list out the various methods of improving commutation in detail with a neat sketch. (13)	BTL1	Remember	CO 4
10.	(i) Derive an expression for the EMF Equation of DC Generator. (7)	BTL4	Analyze	CO 4
	(ii) The lap wound armature has a 4-pole generator has 51 slots. Each slot contains 20 conductors. What will be the emf generated in machine when driven at 1500 rpm. If useful flux per pole is 0.01 Wb? (6)	BTL4	Analyze	CO 4
11.	A 12 pole DC Generator has a simple wave wound armature containing 144 coils of 10 turns each. The resistance of each turn is 0.01 ohm. Its flux per pole is 0.05 Weber and it is running at a speed of 200 rpm. Obtain the induced armature voltage and the effective resistance. (13)	BTL5	Evaluate	CO 4
12.	Explain the different methods of excitation and characteristics of DC Generators with suitable diagram. (13)	BTL4	Analyze	CO 4
13.	With neat sketch explain the following constructional components of DC Machine and its principle (i) Magnetic Frame or Yoke (ii) Pole Core (iii) Field Coils (iv) Armature (v) Armature Winding (vi) Commutator (vii)Brushes and Bearings. (13)	BTL3	Apply	CO 4
14.	Explain the effect of armature reaction in a dc generator. How are its demagnetizing and cross magnetizing calculated. (13)	BTL4	Analyze	CO 4
	PART - C			
1.	A four pole lap wounded shunt generator supplies 60 lamps of 100W, 240V each; the field and armature			

	resistances are 55ohm and 0.18ohm respectively. If the brush drop is 1volt for each brush formulate (i) armature current (ii) current per path (iii) generated emf (iv) power output of dc machine. (15)	BTL6	Create	CO 4
2.	(a) In Armature Reaction Explain the following terms (i) Main field of DC Machine (ii) Armature Field of DC Machine (iii) Interaction between a main field and armature mmf (iv) Armature conductor and Ampere Turns. (8)	BTL5	Evaluate	CO 4
	(b) In commutation Explain the following terms (i) Mechanical Cause of Commutation (ii) Electrical cause of commutation (iii) Process of commutation (iv) Methods to improve commutation. (7)	BTL5	Evaluate	CO 4
3.	A series generator having a combined armature and field resistance of 0.4 ohm is running at 1000 rpm and delivering 5.5 kw at a terminal voltage of 110 V. if the speed is raised to 1500 rpm and the load adjusted to 10 kw, find the new current and terminal voltage. Assume the machine is working on the straight line portion of the magnetization characteristics.(15)	BTL5	Evaluate	CO 4
4.	(i) Obtain the expression for the EMF Equation of a DC Generator. (8)	BTL4	Apply	CO 4
	(ii) Explain the following terms in DC Generator (a) Lap and Wave Winding (b) Compensation Winding.(7)	BTL4	Apply	CO 4

UNIT V DC MOTORS

Principle and operations - types of DC Motors – Speed Torque Characteristics of DC Motors starting and speed control of DC motors –Plugging, dynamic and regenerative braking testing and efficiency – Retardation test- Swinburne's test and Hopkinson's test – Permanent Magnet DC (PMDC) motors- applications of DC Motor.

PART - A

Q.No.	Questions	BTL	Competence	Course Outcome
1.	Define Back emf in a D.C. Motor.	BTL1	Remember	CO 5
2.	List the application of various types of DC Motor.	BTL1	Remember	CO 5
3.	List the merits and demerits of Swinburne's test.	BTL1	Remember	CO 5
4.	Define Speed regulation of DC Motor.	BTL1	Remember	CO 5
5.	Why commutator is employed in d.c.machines?	BTL1	Remember	CO 5
6.	When you will say the motor is running at base speed?	BTL1	Remember	CO 5
7.	Summarize the different techniques used to control the speed of DC Shunt motor.	BTL2	Understand	CO 5
8.	Describe the torque equation of a DC Motor.	BTL2	Understand	CO 5
9.	Give the advantages and disadvantages of Flux control method?	BTL2	Understand	CO 5
10.	Which method is preferred for controlling the speed of DC shunt motor above the rated speed? Justify.	BTL2	Understand	CO 5
11.	Demonstrate How to reverse the direction of rotation of DC Motor?	BTL3	Apply	CO 5

12.	Show at what load does the efficiency is maximum in DC Shunt Machines.	BTL3	Apply	CO 5
13.	Why series motor should not started at no-load?	BTL3	Apply	CO 5
14.	Point out why the Starters necessary for starting DC Motors?	BTL4	Analyze	CO 5
15.	What will happen to the speed of a dc motor when its flux approaches to zero?	BTL4	Analyze	CO 5
16.	Explain why Swinburne's test cannot be performed on DC Series Motor.	BTL4	Analyze	CO 5
17.	Criticize "belt drive not suitable for DC Series Motor why?"	BTL5	Evaluate	CO 5
18.	Explain the significance of back emf in a DC Motor?	BTL5	Evaluate	CO 5
19.	Explain the function of no-volt release in a Three-point starter?	BTL6	Create	CO 5
20.	Mention the effects of differential compounding and cumulatively compound on the performance of DC Compound motor.	BTL6	Create	CO 5
PART - B				
1.	With neat diagram explain the principle, construction and working of DC Motor and its characteristics. (13)	BTL1	Remember	CO 5
2.	Describe briefly the various methods of controlling the speed of a DC Shunt Motor and bring out their merits and demerits. Also, state the situations where each method is suitable. (13)	BTL1	Remember	CO 5
3.	Describe Plugging, dynamic and regenerative braking in DC Motor. (13)	BTL1	Remember	CO 5
4.	A 230 volts DC Shunt motor on no-load runs at a speed of 1200RPM and draw a current of 4.5 Amperes. The armature and shunt field resistances are 0.3 ohm and 230 ohms respectively. Calculate the back EMF induced and speed, when loaded and drawing a current of 36 Amperes. (13)	BTL3	Apply	CO 5
5.	Discuss why starting current is high at the moment of starting a DC Motor? Explain the method of limiting the starting current in DC Motors and also various methods of speed control. (13)	BTL2	Understand	CO 5
6.	With neat sketch explain three point starter to start the DC Shunt Motor. (13)	BTL4	Analyze	CO 5
7.	A DC Series Motor runs at 500 rpm on 220 V supply drawing a current of50 A. The total resistance of the machine is 0.15Ω, calculate the value of the extra resistance to be connected in series with the motor circuit that will reduce the speed to 300 rpm. The load torque being then half of the previous to the current. (13)	BTL3	Apply	CO 5
8.	(i) A 230 V DC shunt motor has an armature circuit resistance of 0.4 ohm and field resistance of 115 ohm. The motor drives a constant torque load and takes an armature current of 20 A at 800 rpm. If motor speed is	BTL4	Analyze	CO 5

	to be raised from 800 to 1000 rpm, find the resistance that must be inserted in the shunt field circuit.(10)			
	(ii) Explain briefly the merits and demerits of Hopkinson's test? (3)	BTL4	Analyze	CO 5
9.	Explain the different methods of excitation and characteristics of a DC Motors with suitable diagrams.(13)	BTL4	Analyze	CO 5
10.	A 400 Volts DC Shunt Motor has a no load speed of 1450 RPM, the line current being 9 Amperes. At full loaded condition, the line current is 75 Amperes. If the shunt field resistance is 200 Ohms and armature resistance is 0.5Ohm. Evaluate the full load speed. (13)	BTL5	Evaluate	CO 5
11.	With the help of neat circuit diagram, explain Swinburne's test and Hopkinson's Test. derive the relations for efficiency (Both for generator and Motor).(13)	BTL1	Remember	CO 5
12.	A 4pole DC series motor has 944 wave connected armature conductors. At a particular load, the flux per pole is 0.04wb and the total torque developed is 260 N-m. Calculate the line current taken by the motor and the speed at which it will run with an applied voltage of 500V. The total motor resistance is 3Ω. (13)	BTL6	Create	CO 5
13.	Explain the construction, principle, working and equivalent circuit of PMDC Motor. (13)	BTL2	Understand	CO 5
14.	A 440 V D.C. shunt motor takes 4A at no load. Its armature and field resistances are 0.4 ohms and 220 ohms respectively. Estimate the kW output and efficiency when the motor takes 60A on full load.(13)	BTL4	Analyze	CO 5
	PART - C			
1.	Determine developed torque and shaft torque of 220V, 4 pole series motor with 800 conductors wave connected supplying a load of 8.2kW by taking 45A from the mains. The flux per pole is 25mWb and its armature circuit resistance is 0.6 ohm. (8)	BTL6	Create	CO 5
	(b) In DC Motor explain the speed versus torque characteristics of DC Motor (i) DC Series Motor (ii) DC Shunt Motor. (7)	BTL6	Create	CO 5
2.	(a) What is meant by Braking of Electric Motor? Explain the following types of Electrical Braking (i) Regenerative Braking (ii) Dynamic or Rheostat Braking (iii) Plugging or Reverse Braking. (8)	BTL6	Create	CO 5
	(b) Explain the different methods for speed control of DC Motor (i) Armature Control (ii) Field Control. (7)	BTL6	Create	CO 5
3.	In a Hopkinson's test on a pair of 500V, 100kW shunt generators, the following data was obtained: Auxiliary supply: 30A at 500V Generator output current: 200A,Field Currents: 3.5A (Generator) and 1.8A (Motor). Armature circuit resistances: 0.075Ω each machine. Voltage drop at the brushes: 2V (each	BTL6	Create	CO 5

	machine). Calculate the efficiency of the machine acting as a generator. (15)			
4.	A 220 V, 22 A, 1000 rpm dc shunt motor has armature circuit resistance of 0.1 ohm and field resistance of 100 ohm. Calculate the value of additional resistance to be inserted in the armature circuit in order to reduce the speed to 800 rpm. Assume the load torque to be (i) proportional to the speed and (ii) proportional to square of the speed (15)	BTL5	Evaluate	CO 5

COURSE OUTCOMES:	
1.	Ability to analyze the magnetic-circuits.
2.	Ability to acquire the knowledge in constructional details of transformers.
3.	Ability to understand the concepts of electromechanical energy conversion.
4.	Ability to acquire the knowledge in working principles of DC Generator.
5.	Ability to acquire the knowledge in working principles of DC Motor.