**DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING**

**AND TECHNOLOGY**

**DEPARTMENT OF**

**ELECTRICAL AND ELECTRONICS ENGINEERING**

QUESTION BANK

III SEMESTER

EE8301 – ELECTRICAL MACHINES-I

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

SUBJECT: EE8301 – ELECTRICAL MACHINES-I SEM / YEAR: IV SEMESTER/II YEAR

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| **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, Hysterisis and Eddy Current losses - AC excitation, introduction to permanent magnets- Transformer as a magnetically coupled circuit | | | |
| **PART – A** | | | |
| **Q.No.** | **Questions** | **BTL** | **Competence** |
| 1. | Explain Statically induced EMF? | BTL5 | Evaluating |
| 2. | Prepare the list of the materials suitable for fabrication of Permanent Magnets. | BTL6 | Creating |
| 3. | Classify the basic types of rotating electric machines? | BTL3 | Applying |
| 4. | What are the types of magnetic losses. | BTL1 | Remembering |
| 5. | Define magnetic flux density. | BTL1 | Remembering |
| 6. | A coil of 1500 turns carrying a current of 5 Amps produces a flux of 2.5mWb. Calculate the self inductance of the coil. | BTL3 | Applying |
| 7. | Define magnetic reluctance. | BTL1 | Remembering |
| 8. | Distinguish statically and dynamically induced EMF. | BTL2 | Understanding |
| 9. | Give the expressions for Hysteresis losses and Eddy current losses and illustrate the various ways to minimize them. | BTL3 | Applying |
| 10. | Define reluctance and permeance. | BTL1 | Remembering |
| 11. | Define Relative Permeability. | BTL2 | Understanding |
| 12. | Define (i) Ampere’s Law (ii) Inductance. | BTL1 | Remembering |
| 13. | Differentiate leakage flux and mutual flux? | BTL2 | Understanding |
| 14. | Define Self Inductance. | BTL2 | Understanding |
| 15. | What are the core losses and how can this loss be minimized? Justify. | BTL5 | Evaluating |
| 16. | Infer fringing effect in a magnetic circuit? | BTL4 | Analysing |
| 17. | Discuss in brief the stacking factor. | BTL3 | Applying |
| 18. | Draw and explain the magnetization curve of  ferromagnetic material. | BTL4 | Analysing |
| 19. | Compare electric and magnetic circuits. | BTL4 | Analysing |
| 20. | Formulate the coefficient of coupling? | BTL6 | Creating |

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| **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) | BTL 3 | Applying |
| 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) | BTL 4 | Analysing |
| 3. | Examine the property of Magnetic Materials (i) Para Magnetic  (ii) Dia Magnetic Materials (iii) Ferro Magnetic Materials. (13) | BTL 3 | Applying |
| 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) | BTL 4 | Analysing |
| 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) | BTL 4 | Analysing |
| 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) | BTL 1 | Rememberin g |
| (ii) List the properties of magnetic material suitable for fabrication Permanent Magnet and Electromagnet. (7) | BTL  1 | Rememberin  g |
| 7. | (i) Describe the AC operation of magnetic circuits. (6) | BTL  1 | Rememberin  g |
| (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) | BTL 1 | Rememberin g |
| 8. | The magnetic circuit has dimensions: Ac=4\*4 cm2, Ig=0.06 cm,  Ic =40 cm and N=600 turns. Assume the value of μr=6000  for iron. Measure the exciting current for Bc =1.2 T and the corresponding flux and flux linkages. (13) | BTL 6 | Creating |
| 9. | (i) Describe the methods of analyzing the magnetic circuits. (6) | BTL1 | Remembering |
| (ii) Examine the typical B-H Curve and hysteresis loops and explain its Concept. (7) |

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| 10  . | (i) Extend the expression for self and mutual inductance of the coil. (6) | BTL2 | Understanding |
| (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 | BTL2 | Understanding |
| 12  . | (i) Give the expression for energy density in the magnetic field. (3) | BTL2 | Understanding |
| (ii) Describe in detail “Eddy-current loss”. (3) | BTL2 | Understanding |
| (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 edd y current loss at each of their frequencies. (7) | BTL2 | Understanding |
| 13  . | Define and Explain the following Laws governing on Magnetic Circuit (i) Magnetic Effect on Current-Right Hand Rule and Cock Screw Rule (ii) Current carrying conductor in Magnetic Field-Fleming’s Left Hand and Right Hand Rule (iii) Statically  Induced EMF and Dynamically Induced EMF. (13) | BTL1 | Remembering |
| 14  . | (i) Compare the similarities and dissimilarities between electric  and magnetic circuits. (6) | BTL5 | Evaluating |
| (ii) Explain the eddy current and eddy current losses in the magnetic circuit. (7) |

to be a) infinity b) 4500. (13)

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| **PART – C** | | | | | | | | |
| 1. | (i) Compare the difference between electric circuit and  magnetic circuit. (7) | | | | | | BTL4 | Analysing |
| (ii)What | is | meant | by induced | emf? Explain | the |

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|  | following types of induced emf (a) Statically Induced 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 | Evaluating |
| 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 | Analysing |
| 4. | A toroidal core made of mild steel has a mean diameter of 16cm and a cross-sectional area of 3cm2. 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 | Analysing |
| **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** | | | | | | | | | | | | |
| 1. | List out the merits and demerits of core and shell type transformer. | | | | | | | | | | BTL5 | Evaluating |
| 2. | How do you reduce leakage flux in a transformer? | | | | | | | | | | BTL2 | Understanding |
| 3. | Show the no load phasor diagram of a transformer. | | | | | | | | | | BTL4 | Analysing |
| 4. | What happens transformer? | | if | DC | supply is | | applied | | to | the | BTL3 | Applying |
| 5. | Give the principle of transformer. | | | | | | | | | | BTL2 | Understanding |
| 6. | List the losses in a transformer? | | | | | | | | | | BTL1 | Remembering |
| 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 | Applying |
| 8. | Describe turns ratio of transformer. | | | | | | | | | | BTL4 | Analysing |
| 9. | Whyis transformer rated in KVA?Justify | | | | | | | | | | BTL1 | Remembering |
| 10. | Explain ideal transformer and draw its phasor diagram? | | | | | | | | | | BTL1 | Remembering |
| 11. | Compose the advantages and applications of auto  transformer. | | | | | | | | | | BTL1 | Remembering |
| 12. | Differentiate transformer. | two | | winding | | transformer | | and | | auto | BTL1 | Remembering |
| 13. | Full load copper loss in a transformer is 1600 W, What will be the loss at half load? | | | | | | | | | | BTL1 | Remembering |
| 14. | Deduce the regulation of a transformer. | | | | | | | | | | BTL5 | Evaluating |
| 15. | Predict the causes of stray losses? | | | | | | | | | | BTL2 | Understanding |
| 16. | Show the condition for parallel operation of a  transformer? | | | | | | | | | | BTL2 | Understanding |
| 17. | Compose the purpose of conducting open circuit test? | | | | | | | | | | BTL6 | Creating |
| 18. | Describe the role of tertiary winding in Transformer. | | | | | | | | | | BTL4 | Analysing |
| 19. | Define all day efficiency. Explain whyall day | | | | | | | | | | BTL2 | Understanding |

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|  | efficiency is lower than commercial efficiency? |  |  |
| 20. | Interpret the Inrush current in a transformer | BTL6 | Creating |
| **PART - B** | | | |
| 1. | Explain the construction, working principle and operation of a transformer. Derive its emf equation. (13) | BTL4 | Analysing |
| 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 | Evaluating |
| 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 | Applying |
| 4. | Develop the equivalent circuit of a single phase transformer referred to primary and secondary. (13) | BTL6 | Creating |
| 5. | Draw and explain the phasor diagram of transformer when it is operating under load. (13) | BTL3 | Applying |
| 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 | Remembering |
| (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 | Evaluating |
| 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 | Understanding |
| (ii) A 500KVA transformer has 95% efficiency at full load and also at 60% of full load both at UPF.   1. Separate out the transformer losses. 2. Measure the transformer efficiency 75% full load, UPF. (7) | BTL2 | Understanding |
| 8. | (i) Obtain the generalised conditions for parallel operation of Transformer. Also explain the effect of load sharing due to impedance variation between  transformers during parallel operation. (7) | BTL6 | Creating |
| (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 | Remembering |
| 9. | A single phase transformer has 180 turns respectively in its secondary and primary windings. | BTL1 | Remembering |

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|  | 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) |  |  |
| 10. | Explain the back to back method of testing for two identical single phase transformers. (13) | BTL2 | Understanding |
| 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 | Analysing |
| 12. | Describe the various three phase transformer connection and parallel operation of three phase  transformer. (13) | BTL1 | Remembering |
| 13. | Describe the method of calculating the regulation and efficiency of a single phase transformer by OC and SC  tests? (13) | BTL1 | Remembering |
| 14. | i) Interpret in detail about the autotransformer, their principle. Arrive at the expression for saving of copper.(10) | BTL4 | Analysing |
| ii) Evaluate in brief the voltage regulation with necessary expressions. (5) |
| **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 | Analysing |
| 2. | A 20 kVA, 2000/200V, 50 Hz, single phase transformer has the following parameters:  r1 = 2.8 Ω, r2=0.02Ω, x11=4.2Ω and x12=0.6Ω.  Calculate (i) Equivalent resistance, leakage reactance and impedance referred to HV side. (ii) Equivalent resistance, leakage reactance and impedance referred  to LV side. (iii) Full load copper loss. (15) | BTL 4 | Analysing |
| 3. | The primary of the transformer is rated at 10A and 1000V. The open circuit reading are V1=1000V, V2=500V, I=.42A, Pac=100W.  The short circuit readings are I1=10A,V1=125V and Pac=400W. Draw the equivalent circuit for the transformer. Predict the ouput voltage for the load impedance ZL=19+j12ohms and draw the phasor  diagram. (15) | BTL 5 | Creating |
| 4. | A 75KVA transformer has 500 turns’ primary and 100 | BTL 5 | Creating |

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|  | turns secondary. The primary and secondary resistances are 0.4 ohm and 0.02ohm respectively and the corresponding leakage reactances are 1.5ohm and 0.045ohm respectively. The supply voltage is 2200V, evaluate (a) equivalent impedance referred to primary circuit and (b) voltage regulation and secondary terminal voltage for full load load at power factor of (i)  0.8 lagging and (ii) 0.8 leading. (15) |  |  |
| **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** | | | |
| 1. | Describe co energy? | BTL2 | Understanding |
| 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 | Analysing |
| 3. | Compose the advantages of analyzing energy conversion devices byfield energy concept? | BTL4 | Analysing |
| 4. | Give the general block diagram of electromechanical energy conversion device. | BTL2 | Understanding |
| 5. | Formulate synchronous speed. Write the expression also. | BTL6 | Creating |
| 6. | Differentiate the pitch factor and distribution factor? | BTL2 | Understanding |
| 7. | Generalize example for singly and multiply excitation systems. | BTL6 | Creating |
| 8. | Explain reactance voltage? | BTL4 | Analysing |
| 9. | List the basic requirements of the excitation systems? | BTL1 | Remembering |
| 10. | Tell why fractional pitched winding is preferred over full. | BTL1 | Remembering |
| 11. | Why the relationship between current and coil flux linkages of electromechanical energy conversion  devices are linear? | BTL1 | Remembering |
| 12. | Show the equation, which relates rotor speed in electrical and mechanical radian/second. | BTL1 | Remembering |
| 13. | Draw the diagram showing the flow of energy in electromechanical energy conversion via coupling  medium. | BTL3 | Applying |
| 14. | Define winding factor? | BTL1 | Remembering |
| 15. | In a linear system Show that field energy and co energy are equal. | BTL3 | Applying |
| 16. | Whar are the cusses for irrecoverable energy loss when  the flux in the magnetic circuits undergoes a cycle? | BTL2 | Understanding |
| 17. | Deduce the assumptions made to determine the distribution of coil mmf? | BTL5 | Evaluating |
| 18. | Define the term pole pitch and coil pitch. | BTL1 | Remembering |
| 19. | Why synchronous machine does not produce torque at any other speed? Justify. | BTL5 | Evaluating |
| 20. | Describe SPP? What is its significance? | BTL2 | Understanding |

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| **PART - B** | | | |
| 1. | Two coupled coils have self and mutual inductance of L11 = 3+0.5x ; L22 = 2+0.5x ; L12 = L21 = 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 | Remembering |
| 2. | Formulate the torque equation of a round rotor machine. Also clearly state the assumptions made. (13) | BTL6 | Creating |
| 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 | Understanding |
| 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 | Analysing |
| 5. | (i) Describe the concept of rotating MMF waves in AC Machine. (6) | BTL1 | Remembering |
| (ii) Obtain an expression for the mechanical  force of field origin in a typical Attracted armature relay. (7) | BTL2 | Understanding |
| 6. | Derive an expression for the magnetic force developed in a multiply excited magnetic systems. (13) | BTL2 | Understanding |
| 7. | Illustrate the necessary expression for co-energy density of an Electromechanical energy conversion  device. (13) | BTL3 | Applying |
| 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 | BTL2 | Understanding |
|  | constant current. (6) |  |  |
|  | (ii) The λ-I characteristics of singly excited |  |  |
|  | electromagnet is given by **i= 121 λ2x2** for **0<i<4 A** |  |  |
|  | and **0<x<10Cm**. If the air gap is 5cm and a current  of 3A is flowing in the coil, Identify (a) Field | BTL1 | Remembering |
|  | Energy (b) Co- energy (c) Mechanical Force on the |  |  |
|  | moving part. (7) |  |  |
| 9. | Describe the m.m.f space wave of one phase of  distributed a.c. winding. (13) | BTL1 | Remembering |
| 10. | (i) Describe the flow of energy in electromechanical devices. (4) | BTL1 | Remembering |
| (ii) Describe about the ‘field energy’ and ‘co energy’in |  | Remembering |

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|  | magnetic system.(4) | BTL1 |  |
| (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 | Remembering |
| 11. | Derive an expression for the magnetic energy stored in a singly excited electromagnetic relay. (13) | BTL4 | Analysing |
| 12. | Evaluate an expression for co-energy density of an electromechanical energy conversion device. (13) | BTL5 | Evaluating |
| 13. | Two windings, one mounted in stator and other at rotor have self a n d mutual inductance of L11 =4.5 and L22 =2.5, L12 =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 i1 = 10 sinωt A. Infer the expression for numerical value in Newton-meter for the instantaneous value of  torque in terms of θ. (13) | BTL4 | Analysing |
| 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= 2Ψ3 + 3(1-x+x2), x˃0.5. Examine the  force on the armature as a function of Ψ. (13) | BTL3 | Applying |
| **PART - C** | | | |
| 1. | The doubly-excited magnetic field has coil self and mutual inductances of  L11=L22=2  L12=L21=cosθ  Where θ is the angle between the axes of the coils. The coils are connected in parallel to a voltage source V=Vmsinωt. 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) | BTL6 | Creating |
| 2. | (i) Explain the concepts of rotating MMF waves in AC Machines. (7) | BTL5 | Evaluating |
| (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 |
| 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 | Analysing |
| 4. | Explain in detailed MMF distribution in AC synchronous machine and derive the expression for  fundamental MMF. (15) | BTL5 | Evaluating |
| **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 interpoles - compensating winding – characteristics of DC generators. | | | |
| 1. | List the factors involved in the voltage buildup of a | BTL1 | Remembering |

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|  | Shunt Generator. |  |  |
| 2. | Why the armature core in a DC machine is constructed with laminated steel sheets instead of solid steel sheets? | BTL1 | Remembering |
| 3. | Define residual EMF in DC Generator? | BTL1 | Remembering |
| 4. | Define back pitch and front pitch. | BTL1 | Remembering |
| 5. | Define winding pitch and commutator pitch. | BTL1 | Remembering |
| 6. | Define Commutation and Commutation period. | BTL1 | Remembering |
| 7. | Differentiate Lap winding and Wave Winding of a DC machine armature. | BTL2 | Understanding |
| 8. | Discuss why the external characteristics of a DC Shunt  Generator is more drooping than that of a separately excited. | BTL2 | Understanding |
| 9. | Discuss the detail under which conditions a dc shunt generator fails to excite. | BTL2 | Understanding |
| 10. | Discuss the purpose of yoke in dc machine. | BTL2 | Understanding |
| 11. | Classify the different types of DC Generators based on method of excitation? | BTL3 | Applying |
| 12. | Demonstrate the armature reaction in DC Generators?  What are its effects? | BTL3 | Applying |
| 13. | Illustrate a schematic diagram indicating flow of  energy in the conversion of Mechanical Energy into Electrical Energy. | BTL3 | Applying |
| 14. | Explain in short the role of inter poles in DC Machines. | BTL4 | Analysing |
| 15. | Pointout why the air gap between the pole pieces and the armature is kept very small? | BTL4 | Analysing |
| 16. | Explain in short the Commutation and Commutation  period. | BTL4 | Analysing |
| 17. | Integrate the Characteristics of all DC Generators in single graph. | BTL5 | Evaluating |
| 18. | Summarize the application of various types of  Generators. | BTL5 | Evaluating |
| 19. | Generalize the requirements of the excitation systems? | BTL6 | Creating |
| 20. | Develop critical resistance of a dc shunt generator. | BTL6 | Creating |
| **PART - B** | | | |
| 1. | (i) Draw and Explain the Internal and External Characteristics of different types of DC Generators.  (6) | BTL1 | Remembering |
| (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) |
| 2. | A separately excited generator when running at 1000rpm supplied 200A at 125V. What will be the load current when the speed drops to 800rpm if If is unchanged? Given that armature resistance=0.04Ω and brush drop=2V. Derive the necessary  equations.(13) | BTL6 | Creating |

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| 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 | Understanding |
| 4. | (i) Explain the armature reaction and commutation in detail for a DC Machine. (6) | BTL4 | Analysing |
|  | (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) |  |  |
| 5. | With neat sketch explain the construction and principle of operation of DC Generator. (13) | BTL2 | Understanding |
| 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 | Applying |
| 7. | (i) Show the condition for maximum efficiency of the DC Generator. (7) | BTL2 | Understanding |
| 1. Explain the following:    1. Self and separately excited DC generators(3)    2. Commutation.(3) | BTL1 | Remembering |
| 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 | Remembering |
|  | (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) |
| 9. | Explain in detail about commutation and list out the  various methods of improving commutation in detail with a neat sketch. (13) | BTL1 | Remembering |
| 10. | (i) Derive an expression for the EMF Equation of DC Generator. (7) | BTL4 | Analysing |
| (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) |
| 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 | Evaluating |

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| 12. | Explain the different methods of excitation and  characteristics of DC Generators with suitable diagram. (13) | BTL4 | Analysing |
| 13. | Explain the following constructional components of DC Machine (i) Magnetic Frame or Yoke (ii) Pole Core (iii) Field Coils (iv) Armature (v) Armature Winding (vi) Commutator (vii) Brushes and Bearings.  (13) | BTL3 | Applying |
| 14. | Explain the effect of armature reaction in a dc generator. How are its demagnetizing and cross magnetizing calculated. (13) | BTL4 | Analysing |

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| **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 | Creating |
| 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 | Evaluating |
| (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) |
| 3. | (i) With suitable neat diagram explain the construction  of a DC Machine and also explain each elements. (8) | BTL4 | Applying |
| (ii) With neat diagram explain principle of operation of  a DC Machine. (7) |
| 4. | (i) Obtain the expression for the EMF Equation of a DC Generator. (8) | BTL4 | Applying |
| (ii) Explain the following terms in DC Generator (a) Lap and Wave Winding (b) Compensation Winding.  (7) |
| **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 | | | |
| 1. | Define Back emf in a D.C. Motor? | BTL1 | Remembering |
| 2. | List the application of various types of DC Motor. | BTL1 | Remembering |
| 3. | List the merits and demerits of Swinburne’s test. | BTL1 | Remembering |
| 4. | Define Speed regulation of DC Motor. | BTL1 | Remembering |
| 5. | Why commutator is employed in d.c.machines? | BTL1 | Remembering |
| 6. | When you will say the motor is running at base speed? | BTL1 | Remembering |

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| 7. | Summarize the different techniques used to control the  speed of DC Shunt motor. | BTL2 | Understanding |
| 8. | Describe the torque equation of a DC Motor. | BTL2 | Understanding |
| 9. | Give the advantages and disadvantages of Flux control method? | BTL2 | Understanding |
| 10. | Express the voltage equation of DC Motor. | BTL2 | Understanding |
| 11. | Demonstrate How to reverse the direction of rotation of DC Motor? | BTL3 | Applying |
| 12. | Show at what load does the efficiency is maximum in DC Shunt Machines. | BTL3 | Applying |
| 13. | Demonstrate How you will change the direction of rotation of a DC Motor. | BTL3 | Applying |
| 14. | Point out why the Starters necessary for starting DC  Motors? | BTL4 | Analysing |
| 15. | What will happen to the speed of a dc motor when its flux approaches to zero? | BTL4 | Analysing |
| 16. | Explain why Swinburne’s test cannot be performed on  DC Series Motor. | BTL4 | Analysing |
| 17. | Criticize “belt drive not suitable for DC Series Motor why?” | BTL5 | Evaluating |
| 18. | Explain the significance of back emf in a DC Motor? | BTL5 | Evaluating |
| 19. | Explain the function of no-volt release in a Three- point starter? | BTL6 | Creating |
| 20. | Mention the effects of differential compounding and  cumulatively compound on the performance of DC Compound motor. | BTL6 | Creating |
| **PART - B** | | | |
| 1. | With neat diagram explain the principle, construction and working of DC Motor and its characteristics. (13) | BTL1 | Remembering |
| 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 | Remembering |
| 3. | Describe Plugging, dynamic and regenerative braking  in DC Motor. (13) | BTL1 | Remembering |
| 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 | Applying |
| 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 | Understanding |
| 6. | With neat sketch explain three point starter to start the DC Shunt Motor. (13) | BTL4 | Analysing |
| 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 | BTL3 | Applying |

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|  | circuit that will reduce the speed to 300 rpm. The load  torque being then half of the previous to the current. (13) |  |  |
| 8. | (i) A 500V DC Shunt Motor running at 700 rpm takes an armature current of50A.Its effective armature resistance is 0.4Ω. What resistance must be placed in series with the armature to reduce the speed to 600  rpm, the torque remaining constant? (7) | BTL4 | Analysing |
| (ii) Explain briefly the merits and demerits of  Hopkinson’s test? (6) | BTL4 | Analysing |
| 9. | Explain the different methods of excitation and characteristics of a DC Motors with suitable diagrams.(13) | BTL4 | Analysing |
| 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 | Evaluating |
| 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 | Remembering |
| 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 | Creating |
| 13. | Explain the construction, principle, working and  equivalent circuit of PMDC Motor. (13) | BTL2 | Understanding |
| 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. | BTL4 | Analysing |
| **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 | Creating |
| (b) In DC Motor explain the speed versus torque characteristics of DC Motor (i) DC Series Motor (ii) DC Shunt Motor. (7) |
| 2. | (a) What is meant by Braking of Electric Motor? Explain the following types of Electrical Braking (i) Regenerative Braking (ii) Dynamic or Rheostatic Braking (iii) Plugging or Reverse Braking. (8) | BTL5 | Evaluating |
| (b) Explain the different methods for speed control of DC Motor (i) Armature Control (ii) Field Control. (7) |
| 3. | In a Hopkinson’s test on a pair of 500V, 100kW shunt | BTL6 | Creating |

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|  | 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 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 | Evaluating |