Lecture Plan -1

Faculty: - Semester: - III Class: - EEE Course Code: - EE-207-F

Subject:- Electrical Machine-I Unit:-I

S. No.	Topic Introduction of Subject, Overview of Syllabus and Basics of Transformer.	Time Allotted:-
1.	Introduction: EM-I covers the basic theory, construction, working and application of Transformer and D.C. machines. The transformer is a static A.C which changes the level of voltage and current without the change of frequency and power.	10 min
2	Division of the Topic - Introduction of subject - Overview of syllabus - Basics of transformer - Basics of DC Machine	30 min
3.	Conclusion: The transformer works on the principle of mutual induction. As the mutual induction is possible in A.C. only, so the transformer works on A.C. only. The Main parts of transformer are core, windings, transformer oil; buchholz's relay Breather, explosion vent, conservator tank.	5 min
4	Question / Answer: Q Can transformer work on D.C.? A No, as the mutual induction is possible in case of a.c. only. Q What is the function of buchholz's relay? A It gives an alarming sound when some fault occurs in transformer.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -2

Faculty: - Semester: - III Class: - EEE Course Code: - EE-207-F

Subject:- Electrical Machine-I Unit:-I

S. No.	Topic :- Transformer : Working principle and EMF Equation	Time Allotted:-
1.	Introduction: Transformer is a static A.C. device which changes the level of voltage and current without changing the frequency and power. Transformer work on the principle of faraday's law of electromagnetic induction.	10 min
2	Division of the Topic - Def. of Transformer - Working Principle of Transformer - Faraday's law of electromagnetic induction - EMF equation of the transformer.	30 min
3.	Conclusion: The transformer works on the principle of mutual induction. As the mutual induction is possible in A.C. only, so the transformer works on A.C. only.	5 min
4	Question / Answer: Q what will be output of transformer if rated D.C is applied on primary winding? A The windings of transformer will be burnt and no output on the sec winding of the transformer. Q What is Faraday's law of EM induction? A The emf induced is equal to the rate of change of magnetic flux linkage or the rate of flux cutting.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Lecture Plan -3

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic :- Transformer : Working at no load and on load conditions	Time Allotted:-
1.	Introduction: The current status in primary and secondary windings at no load and on load condition. Corresponding phasor diagrams and emf equations.	10 min
2	Division of the Topic - Working of transformer at no load condition - Current and flux conditions at on load condition - Working of transformer at on load condition	30 min
3.	Conclusion: At no load condition the transformer current has mainly two components magnetizing current and loss component . At the on load condition an additional current is required called load component of primary current.	5 min
4	Question / Answer: Q What is the function of magnetizing component of No Load current? A The magnetizing component produces a useful flux which is associated with the Secondary winding and primary winding. Q What do you mean by leakage flux? A Leakage flux is the flux which is not associated with the secondary winding.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -4

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic :- Concept of Referred value in transformer and equivalent circuit diagram of transformer	Time Allotted:-
1.	Introduction: To understand the concept of referred value from secondary to primary side and vice-versa. To draws the approximate and exact equivalent circuit diagram of transformer.	10 min
2	Division of the Topic - Equivalent values referred to Primary - Equivalent values referred to Secondary - Approximate equivalent circuit of transformer. - Exact equivalent circuit of transformer	30 min
3.	Conclusion: Secondary windings parameter (voltage, current) can be realized on primary side without known their exact value. All the analysis can be done from the approximate circuit of the transformer	5 min
4	Question / Answer: Q What do you mean by referred to Primary? A Realizing secondary winding parameter (I_2, V_2 and Z_2) on primary winding side. Q Why we do mostly use approximate equivalent circuit of transformer. A To make primary and secondary impedance in series and calculate all the parameter easily.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -5

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic : Construction of single phase transformer.	Time Allotted:-
1.	Introduction: Transformer consists of primary and secondary winding wounded on a laminated core. There are two of core used depending upon the application 1. Core type 2. Shell Type Core is dipped in a non-conducting oil to avoid heating at a particular point and to dissipate heat. Function of buchholz's relay is to gives an alarming sound when some fault occurs in transformer	10 min
2	Division of the Topic - Open circuit test - Short circuit test - Method of supply - Finding the parameters.	30 min
3.	Conclusion: Open circuit test is performed to find the core losses and shunt parameters, short circuit test is performed to find the series parameters and iron losses. Rated voltage is Applied at primary side in case of open circuit test and 5% of rated voltage is applied in case of short circuit test.	5 min
4	Question / Answer: Q1 How to detect moisture in the transformer A1 A silica get is used which turns to green color when there is some moisture in the transformer. Q2 Why are naturally cooling is poor in shell type transformer? A2 Because of embedding of the coils.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -6

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic : Open circuit and short circuit test.	Time Allotted:-
1.	Introduction: Open circuit and short circuit test is performed to find the various parameters of the transformer, core losses and copper losses. There is a specific method of supply given To the transformer at high voltage and low voltage side.	10 min
2	Division of the Topic - Open circuit test - Short circuit test - Method of supply - Finding the parameters.	30 min
3.	Conclusion: Open circuit test is performed to find the core losses and shunt parameters, short circuit test is performed to find the series parameters and iron losses. Rated voltage is Applied at primary side in case of open circuit test and 5% of rated voltage is applied in case of short circuit test.	5 min
4	Question / Answer: Q1 Why we perform the open circuit test? A1 To find the core losses and shunt parameters. Q2 Why we perform the short circuit test? A2 To find the copper losses and series parameters.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Lecture Plan -7

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Transformer: Voltage Regulation and P.U representation of parameters.	Time Allotted:-
1.	Introduction: What is significance of term voltage regulation? Definition and formula for voltage regulation. What is P.U representation of parameters and advantage of using these representations?	10 min
2	Division of the Topic - Regulation of transformer - Effect of pf on voltage regulation - Concept of No load and full load voltage. - P.U resistance, leakage reactance and impedance voltage drops	30 min
3.	Conclusion: The regulation of a transformer is the ratio of difference in no load voltage to full load voltage to full load voltage.	5 min
4	Question / Answer: Q What is significance of voltage regulation of the transformer? A voltage regulation represents the performance of the transformer which is switched from no load to full load i.e. how much voltage is dropped at sec winding Q On which type of load, voltage regulation is generally calculated? A On lagging pf	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -8

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: Efficiency and condition for maximum efficiency in transformer.	Time Allotted:-
1.	Introduction: The definition of efficiency , derivation for the condition of maximum efficiency , Explanation of losses, relation between losses at maximum efficiency. All day efficiency in case of distribution transformers.	10 min
2	Division of the Topic - Definition of efficiency - Derivation for condition of maximum efficiency - Losses in transformer - Relation of losses in case of maximum efficiency.	30 min
3.	Conclusion: In case of maximum efficiency the copper losses are equal to core losses. The efficiency of any system is the ratio of output power to the input power.	5 min
4	Question / Answer: Q1 What are the different losses in transformer? A1 Copper losses and core losses. Q2 What is the condition of maximum efficiency? A2 Copper losses= core losses.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -9

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Transformer: all day efficiency and parallel operation of single phase transformers.	Time Allotted:-
1.	Introduction: Definition and formula all day efficiency. Polarity test of the transformer. Parallel operation of single phase transformers. Condition for parallel operation of the transformer	10 min
2	Division of the Topic - All day efficiency with some examples - Polarity test of the transformer - Parallel operation of single phase transformers	30 min
3.	Conclusion: In case of maximum efficiency the copper losses are equal to core losses. The efficiency of any system is the ratio of output power to the input power.	5 min
4	Question / Answer: Q Why to perform polarity test before transformer connecting in parallel? A To connect transformer in additive polarity. Q What is main disadvantage of parallel operation of transformer? A Maintenance cost of the transformer will increase.	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Lecture Plan -10

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Transformer EMF equation and auto transformer.	Time Allotted:-
1.	Introduction: Derivation of transformer equation based on concept of mutual induction. Definition of auto transformer and it's advantages over two winding transformer in terms of copper saving.	10 min
2	Division of the Topic - EMF equation of transformer - Concept of auto transformer - Advantages of auto transformer - Demerits of auto transformer	30 min
3.	Conclusion: The EMF equation of transformer=4.44 f N Bm A volts The autotransformer is a one winding transformer which can be used for step up as well as step down the voltage.	5 min
4	Question / Answer: Q Write down the EMF equation of transformer? A The EMF equation of transformer= 4.44 f N Bm A Q What is autotransformer? A Auto transformer is a one winding transformer which can be used for step up and step down the voltage.	5 min

Assignment to be given:-

Q1 Explain the working principle and construction of transformer.
Q2 What do you mean by efficiency of transformer, Drive the condition for maximum efficiency.
Q3 Explain the different losses in transformer
Q4 Explain the working principle and construction of DC machine.

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -11

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - 3-phase Transformer.	Time Allotted:-
1.	Introduction: The concept of three phase transformers. Construction of three phase transformer.	10 min
2	Division of the Topic - EMF equation of transformer - Construction of three phase transformer	30 min
3.	Conclusion: The EMF equation of transformer=4.44 f N B_m A volts The three phase transformer can have four type of connections according to load conditions.	5 min
4	Question / Answer: Q Write down the EMF equation of transformer? A The EMF equation of transformer= 4.44 f N B_m A Q What are the advantages of 3 phase transformer over 1 phase transformer? A 3 phase transformer gives high output power and high efficiency.	5 min

Assignment to be given:-NIL
Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan-12

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - 3-phase Transformer: Various types of connections for three phase Transformers.	Time Allotted:-
1.	Introduction: Working of three phase transformers and different connections for three phase transformers. Zig-Zag connection of transformer.	10 min
2	Division of the Topic - Different connections for three phase transformers - Comparative feature of connection - Zig-Zag connection of transformer.	30 min
3.	Conclusion: Depending upon the application, different type of star-delta connection are used in three phase transformer.	5 min
4	Question / Answer: Q1 Write down the EMF equation of transformer? A1 The EMF equation of transformer= 4.44 f N B_m A Q2 What is the condition of maximum efficiency? A2 Copper losses= core losses.	5 min

Assignment to be given:-NIL
Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -13

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Open-delta or V-V connection and its application	Time Allotted:-
1.	Introduction: If one winding of Δ-Δ system is damaged or accidently opened then transformer can be continue to supply 3-phase power with rating reduced to about 58%. This is known as open-delta or V-V system.	10 min
2	Division of the Topic - Open delta connection - Reduced rating compare to full load Δ-Δ connection - Application of V-V connection	30 min
3.	Conclusion: In case one winding of Δ-Δ system is damaged or accidently opened then transformer can be continue to supply 3-phase power with rating reduced to about 58%.	5 min
4	Question / Answer: Q1 How much rating of transformer reduced in V-V connection? A1 about 58% of rated Δ-Δ connection Q2 What is the main advantage of V-V connection? A2 As a temporary measure when one transformer of a Δ-Δ system damaged and removed for repair and maintenance.	5 min

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -14

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Scott connection and its application	Time Allotted:-
1.	Introduction: Scott connection is most common method used for three phase to two phase conversion. The two transformers are connected electrically but not magnetically.	10 min
2	Division of the Topic - Scott connection - Relationship between input and output currents - Application of scott connection	30 min
3.	Conclusion: Scott connection is used for conversion of three phases to two phase conversion. Scott connection can be used to operate high load single phase like furnaces	5 min
4	Question / Answer: Q1 Name two application of scott connection A1 Furnace and electric train	5 min

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -15

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Three phase to six phase and three phase to twelve phase conversion	Time Allotted:-
1.	Introduction: A smoother waveform is obtained on dc side as the number of phase increased. Objectionable harmonics in alternating currents are also reduced with a greater number of phases. The efficiency of conversion from ac to dc by rectifier and thysistor increase in number of phases.	10 min
2	Division of the Topic - Double Star Connection - Double delta Connection - Three phase to twelve phase transformation	30 min
3.	Conclusion: In order to achieve smother waveform on dc side using ac o dc converter, Three phases to six phases and three phases to twelve phases conversion methods are used.	5 min
4	Question / Answer: Q1 In which way input windings are connected in three phase to six phase conversion? A1 Δ-Δ connection Q1 In which way output windings are connected in three phase to six phase conversion? A2 Secondaries is connected in star and other in reversed star.	5 min

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -16

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: -Parallel operation of three phase transformers.	Time Allotted:-
1.	Introduction: Polarity test of the transformer. Parallel operation of three phase transformers. Condition for parallel operation of the transformer	10 min
2	Division of the Topic - Polarity test of the transformer - Parallela operation of three phase transformers Advantage of Parallel operation of three phase transformers.	30 min
3.	Conclusion: In order to increase the reliability of the system, the transformer are connected in parallel.	5 min
4	Question / Answer: Q Why to perform polarity test before transformer connecting in parallel? A To connect transformer in additive polarity. Q What is main disadvantage of parallel operation of transformer? A Maintenance cost of the transformer will increase.	5 min

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -17

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Nature of magnetizing current and Inrush current	Time Allotted:-
1.	Introduction: A transformer is designed to operate in the saturation region of the magnetic core if it is operated at a higher core flux density. The waveform of the no-load current i_o can be found from the sinusoidal flux waveform. When transformer is initially energized, there is sudden inrush of primary current. The max value attained by the flux is over twice the normal flux.	**10 min**
2	Division of the Topic - Nature of magnetizing current - Inrush current	**30 min**
3.	Conclusion: Under load condition the total primary current is equal to the phasor sum of load current and no-load current. Core flux attains the maximum value of the flux to ($2\ \phi_m+\phi_r$) which is over twice the normal flux. This is called doubling effect.	**5 min**
4	Question / Answer: Q1 which harmonic is most dominant in transformer. A1 3rd harmonic Q2 How much percent of fundamental harmonic, 3rd harmonic exits at 150% of rated voltage A2 30-40% of the fundamental	**5 min**

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -18

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic: - Types of Cooling methods in the transformer	Time Allotted:-
1.	Introduction: To remove the heat generated in windings due to I^2R losses, various types of cooling methods are used in the transformer. Conservator is a air tight metal drum placed above the level of the top of tank.	**10 min**
2	Division of the Topic - Need of cooling methods in the transformer - Types of cooling methods	**30 min**
3.	Conclusion: In order to avoid burnt of windings of transformer, various cooling methods are used in the transformer.	**5 min**
4	Question / Answer: Q1 For how much rating Oil natural cooling method is used? A1 25 KVA Q2 What are the various types of losses in the core of transformer A2 Eddy current loss and hysteresis loss	**5 min**

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -19

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Basic theory of DC generator & brief idea of construction	Time Allotted:-
1.	**Introduction** An electrical generator is a machine which converts mechanical energy (or power) into electrical energy (or power).The energy conversion is based on the principle of production of dynamically induced EMF.	10 min
2	**Division of the Topic** -Basic theory of D.C generator & -Brief idea of construction	30 min
3.	**Conclusion** In dc generator the electrical conversion is based on the principle of production of dynamically (or motionally) induced EMF.	5 min
4	**Question / Answer** Q1.What is the function of generator? A1.It basically converts mechanical energy (or power) into electrical energy (or power). Q2.On what principle does the dc generator works? A2.It works on the principle of production of dynamically (or motionally) induced emf.	5 min

Assignment to be given:-NIL

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision: 00

Lecture Plan 20

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-EMF equation & load characteristics of D.C Generator	Time Allotted:-
1.	**Introduction** In general generated EMF $Eg = \frac{\Phi PN}{60A} * (P/A)$ Here Φ = flux/pole in Weber Z = Total number of armature conductors. A = Number of parallel paths in armature. P = Number of generator poles. N = Armature rotation in revolutions per minute (r.p.m) The load characteristics give the relationship between terminal voltage & field current for constant armature current & speed.	10 min
2	**Division of the Topic** -EMF equation -Load characteristics of D.C. Generator -	30 min
3.	**Conclusion** For Lap winding, A = P & for Wave winding A = 2 always.	5 min
4	**Question / Answer** Q1.In a D.C generator, the generated EMF is directly proportional to the -------. A1.Pole flux (Φ). Q2.In lap winding, the number of parallel paths is equal to the ----------. A2.Number of poles.	5 min

Assignment to be given:-Nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision :00

Lecture Plan 21

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Basic theory of D.C motor & concept of back EMF.(E_b) .	Time Allotted:-
1.	**Introduction** An electric motor is a machine which converts electrical energy into mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Flemings Left-hand Rule. The direction of back e.m.f. is given by Fleming's Right –hand Rule. In general generated e.m.f. $E_b = \frac{\Phi PN}{60A} * (P/A)$ Here Φ = flux/pole in weber Z = Total number of armature conductors. A = Number of parallel paths in armature. P = Number of motor poles. N = Armature rotation in revolutions per minute (r.p.m)	10 min 30 min
2	**Division of the Topic** - Basic theory of D.C motor & -Concept of back e.m.f.	
3.	**Conclusion** The D.C motor is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Flemings Left-hand Rule. The direction of back EMF is given by Fleming's Right –hand Rule.	5 min
4	**Question / Answer** Q1.In a D.C motor, the generated EMF is directly proportional to the -------. A1.Pole flux (Φ). Q2.The direction of back EMF is given by ----------. A2. Fleming's Right –hand Rule.	5 min

Assignment to be given:- Nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision: 00

Lecture Plan 22

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Construction of DC Machine.	Time Allotted:-
1.	**Introduction** A rotating electric machine has two parts, stator and rotor separated by air gap. A DC machine consists of three main parts : 1. Magnetic-field system 2. Armature 3. Commutator and brush gear	10 min
2	**Division of the Topic** - Construction of DC machine - Working of commutator	30 min
3.	**Conclusion** The D.C motor is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Flemings Left-hand Rule. Function of commutator is to convert AC into DC in case of generator and DC into AC in case motor.	5 min
4	**Question / Answer** Q1.In a D.C motor the generated EMF is directly proportional to the -------. A1.Pole flux (Φ). Q2.The direction of induced EMF in generator is given by ----------. A2. Fleming's Right –hand Rule.	5 min

Assignment to be given:- Nil

Reference Readings:-

- Electrical Machines – (vol. – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision :00

Lecture Plan 23

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Classification of DC generator and their equivalent ckt diagram	Time Allotted:-
1.	**Introduction** Depending upon the connection between rotor winding & stator winding and types of excitation, DC generator can classified into following 1. Separately excited DC generator 2. DC series generator 3. DC shunt generator 4. DC compound generator	10 min
2	**Division of the Topic** - Types of DC generator - Application of DC generator	30 min
3.	**Conclusion** In series motor torque α Ia^2 & in shunt motors torque α Ia. For high starting load application DC series machine.	5 min
4	**Question / Answer** Q1.Write the torque equation of D.C motor in N-m. A1. T = 0.159ΦZIa*(P/A) N-m. Q2.In D.C series motor torque is directly proportional to --------- A2.Square of armature current (Ia^2).	5 min

Assignment to be given:-

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision :00

Lecture Plan 24

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Power balance equation of various DC generator	Time Allotted:-
1.	**Introduction** According to power balance, input power to machine must be equal to output power and losses.	10 min
2	**Division of the Topic** **-**Power balance equation of various DC generator	30 min
3.	**Conclusion** The production of magnetic flux in the machine by circulating current in the field windings is called excitation. In self excitation the current flowing through the field winding is supplied by the machine itself	
4	**Question / Answer** Q1.What is pole pitch? A1 It is defined as number of conductor per pole. Q2 On what principle does the generator operate? A2 The generator operator on the principle of principle of production of dynamically induced EMF.	5 min 5 min

Assignment to be given:- NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision :00

Lecture Plan 25

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:- Armature Reaction in DC generator	Time Allotted:-
1.	**Introduction** The effect of magnetic field setup by armature current on the distribution of flux under the main poles of a dc machine is known as armature reaction.	10 min
2	**Division of the Topic** - Concept of G.N.P and M.N.P - Armature reaction - Remedies for field distortion	30 min
3.	**Conclusion** Brushes are placed on M.N.P to avoid cross-magnetization. By making trailing pole piece longer than the advancing horn and cutting farther from the surface of the armature so as to equalize the distribution of magnetic flux.	5 min
4	**Question / Answer** Q1.What is the effect of cross-magnetization? A1. It decrease in main flux in load due to armature reaction may be around 10% Q2. What is the nature of the dc armature mmf waveform? A2. Triangular	5 min

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/20
Revision: 00

Lecture Plan 26

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Commutation and methods for improving commutation	Time Allotted:-
1.	**Introduction** The commutation process involves the change from a generated alternating current to an externally available direct current. The transfer of current from the rotating armature to the stationary brushes involves a continuously moving contact.	10 min
2	**Division of the Topic** - Commutation in DC generator - Methods of improving commutation - Compensating winding	30 min
3.	**Conclusion** Good commutation means no sparking at the brushes and with commutator surface remaining unaffected during continuous operation of the dc machine. For satisfactory commutation the current in a coil undergoing commutation must be completely reversed during its commutation period.	5 min
4	**Question / Answer** Q1. Why in dc machine sometimes brushes are shifted from neutral axis by a small angle? A1.So as to lie along MNP to provide sparkles commutation Q2.What is reactance emf in dc machines? A2. The self-induced emf in the coil undergoing commutation is called the reactance voltage.	5 min

Assignment to be given: - nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/0/15
Revision :00

Lecture Plan- 27

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Voltage regulation and application of DC generators	Time Allotted:-
1.	**Introduction** The voltage regulation is a term that may be used for determining the performance of the generator. Lower the voltage regulation better it is. Ideally, a shunt generator should maintain a constant voltage.	10 min
2	**Division of the Topic** - Voltage regulation - Condition for self-excitation - Applications of DC generator	30 min
3.	**Conclusion** For a series wound generator, the resistance of the external circuit should be less that the critical resistance. Shunt generator with field regulator are used for light and power supply purposes.	5 min
4	**Question / Answer** Q1.What is the application of Differential compound wound DC generator? A1.It can be used for constant current load application such as arc welding Q2.What is the application of Cummulative compound wound DC generator? A2. For lighting and power services.	5 min

Assignment to be given:-

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan- 28

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Parallel operation of DC generators	Time Allotted:-
1.	**Introduction** To increase the reliability of the system DC generators are used to operate in parallel. The smaller units can be operated in various parallel combinations, as per actual demand.	10 min
2	**Division of the Topic** - Condition for parallel operation of DC generator - Parallel operation of various types of DC generator	30 min
3.	**Conclusion** With the use of parallel operation of smaller units of DC generator, the efficiency, reliability of the system increases	5 min
4	**Question / Answer** Q1.Why is it desirable that the generators operating in parallel should have same voltage regulation? A1.So as to share the total load in proportion to their respective rated capacity. Q2. Is equalizer bar needed for parallel operation of under-compounded generators? A2.No	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan-29

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Characteristics of DC series and DC shunt motor	Time Allotted:-
1.	**Introduction** Three types of characteristics are studied. Speed /torque, Speed/armature current and torque armature current characteristics of DC shunt and DC series motor.	10 min
2	**Division of the Topic** - Characteristics of DC shunt motor - Characteristics of DC series motor	30 min
3.	**Conclusion** The D.C motor is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Flemings Left-hand Rule. DC series motor can not be started without a load as the no load speed is very high.	5 min
4	**Question / Answer** Q1.In a D.C motor , the generated e.m.f is directly proportional to the -------. A1.Pole flux (Φ). Q2.The direction of back e.m.f is given by ----------. A2. Fleming's Right –hand Rule.	5 min

Assignment to be given:-NIL

Reference Readings: -

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -30

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Torque & power equations + Load characteristics of D.C motor	Time Allotted:-
1.	**Introduction** By the term torque is meant the turning or twisting moment of a force about an axis. It is given as $T = 0.159\Phi ZIa*(P/A)$ N-m. The electrical power converted into mechanical power in the armature is given as $P = EbIa$. The characteristics curves of a motor are those curves which shows the relationship between torque & armature current , speed & armature current , speed & torque .	10 min
2	**Division of the Topic** -Torque & power equations - Load characteristics of D.C motor - Torque & armature current - Speed & armature current - Speed & torque .	30 min
3.	**Conclusion** In series motor torque α Ia^2 & in shunt motors torque α Ia.The characteristics of a motor shows the relationship between torque & armature current, speed & armature current, speed & torque.	5 min
4	**Question / Answer** Q1.Write the torque equation of D.C motor in N-m. A1. $T = 0.159\Phi ZIa*(P/A)$ N-m. Q2.In D.C series motor torque is directly proportional to --------- A2.Square of armature current (Ia^2).	5 min

Assignment to be given:-NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -31

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Staring methods of D.C motors	Time Allotted:-
1.	**Introduction** The various types of starters are used for starting shunt & compound motors. Speed can be controlled by varying (i) flux/pole ,Φ (flux control) (ii)Resistance of armature circuit (Rheostatic control) & (iii)Applied voltage (Voltage control).These methods can be applied to shunt, series & compound motors.	10 min
2	**Division of the Topic** - Starting D.C motors	30 min
3.	**Conclusion** The various types of starters are used for starting shunt & compound motors. The three point and four point starters are used for starting the DC motors.	5 min
4	**Question / Answer** Q1.Three point starter is used to change ------- A1 The resistance of the circuit. Q2. Flux control method is used when speeds ---------- is required. A2.Above synchronous speed.	5 min

Assignment to be given: - NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -32

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:- Speed control of D.C motors	Time Allotted:-
1.	**Introduction** The various types of speed control methods are used for starting shunt & compound motors. Speed can be controlled by varying (i) flux/pole ,Φ (flux control) (ii)Resistance of armature circuit (Rheostatic control) & (iii)Applied voltage (Voltage control).These methods can be applied to shunt , series & compound motors.	10 min
2	**Division of the Topic** -Speed control of D.C motors	30 min
3.	**Conclusion** The various types of speed control methods are used for starting shunt & compound motors. Flux control method is used when speeds above synchronous speed is required. Armature control method is used when speeds below the no-load speed are required. Voltage control (especially Ward-Leonard system) is used when very sensitive speed control is required.	5 min
4	**Question / Answer** Q1.Armature control method is used when speed----------is required. A1.Below no-load speed. Q2. Flux control method is used when speeds ---------- is required. A2.Above synchronous speed.	5 min

Assignment to be given:-Nil
Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan -33

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Classification of DC motor and their equivalent ckt diagram	Time Allotted:-
1.	**Introduction** Depending upon the connection between rotor winding & stator winding and types of excitation, DC motor can classified into following 1. Separately excited DC motor 2. DC series motor 3. DC shunt motor 4. DC compound motor	10 min
2	**Division of the Topic** - Types of DC motor - Application of DC motor	30 min
3.	**Conclusion** In series motor torque α Ia^2 & in shunt motors torque α Ia. For high starting load application DC series machine.	5 min
4	**Question / Answer** Q1.Write the torque equation of D.C motor in N-m. A1. $T = 0.159\Phi ZIa*(P/A)$ N-m. Q2.In D.C series motor torque is directly proportional to --------- A2.Square of armature current (Ia^2).	5 min

Assignment :
Q1 Explain the working principle of DCmotor.
Q3 Explain the torque speed characteristics for DC series motor.

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan- 34

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Power balance equation of various DC motor	Time Allotted:-
1.	**Introduction** According to power balance, input power to machine must be equal to output power and losses.	10 min
2	**Division of the Topic** - Power balance equation of various DC motor	30 min
3.	**Conclusion** The production of magnetic flux in the machine by circulating current in the field windings is called excitation. In self-excitation the current flowing through the field winding is supplied by the machine itself	5 min
4	**Question / Answer** Q1.What is pole pitch? A1 It is defined as number of conductor per pole. Q2 On what principle does the generator operate? A2 The generator operator on the principle of principle of production of dynamically induced EMF.	5 min

Assignment to be given:-Nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Lecture Plan -35

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:- Armature Reaction in DC motor	Time Allotted:-
1.	**Introduction** The effect of magnetic field setup by armature current on the distribution of flux under the main poles of a dc machine is known as armature reaction.	10 min
2	**Division of the Topic** - Concept of G.N.P and M.N.P - Armature reaction - Remedies for field distortion	30 min
3.	**Conclusion** Brushes are placed on M.N.P to avoid cross-magnetization. By making trailing pole piece longer than the advancing horn and cutting farther from the surface of the armature so as to equalize the distribution of magnetic flux.	5 min
4	**Question / Answer** Q1.What is the effect of cross-magnetization? A1. It decrease in main flux in load due to armature reaction may be around 10% Q2. What is the nature of the dc armature mmf waveform? A2. Triangular	5 min

Assignment to be given:- NIL

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan- 36

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Commutation and methods for improving commutation	Time Allotted:-
1.	**Introduction** The commutation process involves the change from a generated alternating current to an externally available direct current. The transfer of current from the rotating armature to the stationary brushes involves a continuously moving contact.	10 min
2	**Division of the Topic** - Commutation in DC generator - Methods of improving commutation - Compensating winding	30 min
3.	**Conclusion** Good commutation means no sparking at the brushes and with commutator surface remaining unaffected during continuous operation of the dc machine. For satisfactory commutation the current in a coil undergoing commutation must be completely reversed during its commutation period.	5 min
4	**Question / Answer** Q1. Why in dc machine sometimes brushes are shifted from neutral axis by a small angle? A1.So as to lie along MNP to provide sparkles commutation Q2.What is reactance emf in dc machines? A2. The self-induced emf in the coil undergoing commutation is called the reactance voltage.	5 min

Assignment to be given:-Nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan- 37

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Braking in DC motors	Time Allotted:-
1.	**Introduction** In large machine, due to high inertia, the time elapsing before it stops will be especially long. So it is essential, however, in many cases that motor and its driven machine be stopped quickly	10 min
2	**Division of the Topic** - Need of braking system in DC motor - Types of electric braking.	30 min
3.	**Conclusion** The device employed for braking absorbs the kinetic energy of the moving parts while one in second one, it absorbs, in addition to the kinetic energy, potential energy, usually gravitational, which can drive the system at an excessively high speed.	5 min
4	**Question / Answer** Q1.How plugging of a dc motor is done? A1 Plugging is obtained in a dc motor by reversing the supply terminals to the armature of the motor. Q2. What is the most economical method to plugging? A2. Regenerative braking	5 min

Assignment to be given:- Nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Lecture Plan-38

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Various types of losses in DC machines and condition for max efficiency	Time Allotted:-
1.	**Introduction** The input energy to the machine is converted into useful output energy and losses various parts of the machine. It is desirable to separate each losses into its components and determine what values they have as well as the way in which they vary with load and speed.	10 min
2	**Division of the Topic** - Types of losses in DC machine - Efficiency of DC machine - Condition of efficiency in DC machine	30 min
3.	**Conclusion** Efficiency of DC machine will be maximum when variable losses are equal to constant losses.	5 min
4	**Question / Answer** Q1.How the eddy current losses will change if the thickness of lamination is increased? A1 Eddy current losses vary as the square of the thickness of lamination is increases. Q2. Why CRO cannot be used in small rotating machines? A2. In small rotating machines it is difficult to correspond the axis of core with the rolling direction	5 min

Assignment to be given:- Nil

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Lecture Plan-39

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Testing of DC machine	Time Allotted:-
1.	**Introduction** The most important performance test to be conducted on dc machine are: 1. The magnetization or open-circuit test. 2. The load characteristic 3. The determination of efficiency curve 4. The temperature rise test.	10 min
2	**Division of the Topic** - Testing of DC machine	30 min
3.	**Conclusion** The various types of testing methods are used for determining the performance of DC machine.	5 min
4	**Question / Answer** Q1.Can brake test be applied to a dc series motor? A1. Yes. Q2. What is the main drawback of brake test? A2. The output of the motor cannot be measured accurately	5 min

Assignment to be given:-

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.

Doc. No.: DCE/00/20
Revision: 00

Lecture Plan - 40

Faculty: - Semester:- III Class:- EEE Course Code:- EE-207-F

Subject: - Electrical Machine-I Unit:-I

S. No.	Topic:-Applications of D.C motors	Time Allotted:-
1.	**Introduction** The D.C motors find wide range of applications due to its high starting torque. The shunt motor is widely used with loads that require essentially constant speed but high starting torques is not needed. Series motors are used where high starting torque is required.	10 min
2	**Division of the Topic** - Applications of D.C motors - Series motors -Shunt motors - Commutative compound motors	30 min
3.	**Conclusion** Shunt motors are used in centrifugal pump, fans, machine tools etc. Series motors are used for street cars, cranes, hoists & for electric railway operation. Commutative compound motors are used for intermittent high torque loads, Elevators, Rolling mills etc.	5 min
4	**Question / Answer** Q1.list the application of D.C shunt motors. A1.Centrifugal pump, fans, machine tools etc. Q2.List the applications of D.C series motors. A2.Street cars, cranes, hoists & for electric railway operation.	5 min

Assignment:
Q1 What is the significance of back EMF?
Q2 Explain the working principle of D.C. motor. and D.C. generator.
Q3 What are the various characteristics of D.C. motor and D.C. generator.

Reference Readings:-

- Electrical Machines – (Vol – II) By B L Theraja , S Chand
- Electric Machines: I.J. Nagrath and D.P. Kothari, TMH, New Delhi.