Minor-1

20EETM01: DC MACHINES & TRANSFORMERS

Credits - 4 **Sessional Marks: 30**

L: T: P:: 3:1:0 **University Exam Marks: 70**

Course Objectives:

1. To Import Knowledge on constructional features of DC machines and different types of windings Employed in DC Machines.
2. To study about the characteristics of generators and speed control of DC motors and applications of DC Motors.
3. To get knowledge on various types of losses that occurs in DC machines and how to calculate efficiency and Testing of DC motors.
4. To familiarize the predetermination of regulation and efficiency of transformer from OC and SC test results
5. To know about the parallel operation of transformers

Course Outcomes:

On successful completion of the course, students will be able to

CO1. Understand principles of DC machines, Singly Excited and Multi Excited Magnetic Systems.
CO2. Apply knowledge to solve problems relating to DC machines and Transformers.
CO3. Compute system losses and their components/factors and their reduction.
CO4. Analyse performance of DC machines and Transformers from the results of experiments.
CO5. Describe the Testing of DC machines.

UNIT-I

D.C. Generators: D.C. Generators – Principle of Operation – Constructional Features – Armature Windings – Lap and Wave Windings – Simplex and Multiple-Windings –E.M.F Equation–Numerical Problems – Parallel Paths-Armature Reaction –Commutation –Types- Reactance Voltage – Methods of Improving Commutation.

UNIT-II

Methods of Excitation –Building up of E.M.F – Critical Field Resistance and Critical Speed - Causes for Failure to Self Excite and Remedial Measures-Load Characteristics of Shunt, Series and Compound Generators – Parallel Operation of D.C Series Generators – Use of Equalizer Bar and Cross Connection of Field Windings – Load Sharing.

UNIT-III

D.C. Motors: D.C Motors – Principle of Operation – Back E.M.F. – Circuit Model – Torque Equation – Characteristics and Application of Shunt, Series and Compound Motors –Speed Control of D.C. Motors: Armature Voltage and Field Flux Control Methods. Ward-Leonard System–Braking of D.C Motors –

Permanent Magnet D.C Motor (PMDC). Motor Starters (3 Point and 4 Point Starters) – Protective Devices-Calculation of Starters Steps for D.C Shunt Motors.

UNIT-IV

Testing Of Dc Machines: Losses – Constant & Variable Losses – Calculation of Efficiency – Condition for Maximum Efficiency. Methods of Testing – Direct, Indirect – Brake Test – Swinburne's Test – Hopkinson's Test – Field's Test – Retardation Test.

UNIT-V

Transformers: Principle, construction and operation of single phase transformers, phasor diagram, equivalent circuit, voltage regulation, losses and efficiency. Testing- Open & short circuit tests, All-day efficiency, Sumpner's test, Separation of hysteresis and eddy current losses, Parallel operation, Autotransformer, Three phase Transformer, Scott connections, cooling methods.

Text Books:

1. "Electrical Machines", P.S. Bimbra, 7th ed., Khanna Publishers., 2007.
2. "Electrical Machines", I.J Nagrath& D.P Kothari, 3rd ed., Tata Mc Graw-Hill, 2009.

Reference Books:

1. "Performance and Design of DC Machines", by . A.E. Clayton & Hancock, 3rd ed., BPB Publishers, 2004.
2. "Performance and Design of A.C Machines", M.G Say, 3rd ed., BPB Publishers, 2002.
3. "Electric Machinery", by A.E.Fitzgerald, C Kingsley and S Umans, 7th ed., McGraw Hill, 2013.
4. M.Ramamoorthy& O.Chandrasekhar, "Electrical Machines", PHI Publishers, 2017.

Course Outcome-Program Outcome- Program Specific Outcomes (CO-PO-PSO) Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**
CO2	**M**	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**M**	**H**	**-**
CO3	**L**	**H**	**-**	**-**	**-**	**H**	**-**	**-**	**-**	**M**	**M**	**-**	**-**	**H**	**-**
CO4	**L**	**H**	**M**	**H**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**H**	**-**
CO5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**-**

Minor-2

20EETM02: AC ROTATING MACHINES

Credits - 4 **Sessional Marks: 30**

L: T: P:: 3:1:0 **University Exam Marks: 70**

Course Objectives

1. To impart the knowledge on fundamentals of AC Rotating Machines.
2. To Familiarize the constructional details, principle of operation of three phase alternator and Synchronous Motor.
3. To get the Knowledge on Constructional details, principle of operation, Performance, stator, Speed Control and breaking of three phase induction Motor.
4. To Study the constructional details, principle of operation, type of single phase Induction Motor and Special Machines.

Course Outcomes

After completion of the course the student will able to

CO1. Understand the principles of AC Machines

CO2. Apply knowledge to solve problems relating AC Machines

CO3. Compute system losses and their components/factors and their reduction.

CO4. Analyse performance of AC machines from the results of experiments.

UNIT-I

Basic concepts of AC Machines: Concentrated and Distributed Windings – Integral Slot and Fractional Slot Windings – Pitch, Distribution, Winding Factors. Principle And Constructional Features of Salient Pole and Round Rotor Machines E.M.F Equation- Harmonics in Generated E.M.F – Elimination of Harmonics, Winding factors.

UNIT-II

Induction Machines: Constructional features, production of torque, phasor diagram, equivalent circuit, performance analysis, torque-slip characteristics. No Load and blocked rotor test, load test. Effect of rotor resistance, deep bar and double cage induction motor. Starting- Starting methods of squirrel cage and wound rotor induction motor.

UNIT-III

Speed Control- Various methods of speed control of squirrel cage and wound rotor induction motor. Effects of space harmonics.

Single phase induction motors- Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split phase starting methods &applications.

UNIT-IV

Synchronous Machines: Constructional features. Cylindrical rotor machine- Synchronous Generator-Generated e.m.f., circuit model and phasor diagram, armature reaction, synchronous impedance, voltage regulation and different methods for its estimation.

UNIT-V

Synchronous Motor- Operating principle, circuit model, phasor diagram, effect of load. Operating characteristics of synchronous machines, V-curves, starting methods of synchronous motors. Parallel operation of Alternators-Synchronization and load division.

Text Books:

1. "Electrical Machines", P.S. Bimbra, 7th ed., Khanna Publishers., 2007.
2. "Electrical Machines", I.J Nagrath& D.P Kothari, 3rd ed., Tata Mc Graw-Hill, 2009.

Reference Books:

1. "Theory of Alternating Current Machinery" by Alexander S Langsdorf,2nd ed., Tata Mc Graw-Hill,2001.
2. "Performance and Design of A.C Machines", M.G Say, 3rd ed., BPB Publishers, 2002
3. "Electric Machinery", A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw-Hill Companies, 7th edition, 2013.

Course Outcome-Program Outcome- Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**H**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**M**	**H**	**-**
CO2	**M**	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**L**	**M**	**H**	**L**
CO3	**M**	**H**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**M**	**H**	**L**
CO4	**-**	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**M**	**H**	**M**

Minor-3

20EETM03: ELECTRICAL POWER GENERATION & TRANSMISSION

Credits – 4 **Sessional Marks: 30**

L: T: P:: 3:1:0 **University Exam Marks: 70**

Course objectives

1. To Gain knowledge on the performance of short, medium & long transmission lines.
2. To analyse the transients of power system.
3. To solve the problems related to the economic dispatch of power, plant scheduling, unit Commitment and formulate strategies to minimize transmission line losses and penalties Imbibed.
4. To know the importance of compensation in power system and study the different Compensating techniques.

Course out comes

On successful completion of the course, students will be able to

CO1. Have Knowledge on Performance of short, medium & long transmission lines.
CO2. Do calculation of power system Transients.
CO3. Explain methods for economic load dispatch and unit commitment.
CO4. Design the mathematical models of the mechanical and electrical components involved in the operation of power systems with the voltage and frequency control of single area or interconnected multi area power systems.
CO5. Explore the methods for active and reactive power control.

UNIT-I

Introduction: Organization of power sector in India, Layout & Operation of Thermal, Hydro, Nuclear power stations. Overview of Solar & Wind Power Plants, Economics of generation, load curves, Demand Factor, load factor, diversity factor, Plant Capacity Factor, Plant Use Factor & Utilization Factor.

UNIT-II

Transmission line parameters: Types of conductors - calculation of resistance for solid conductors - Calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR & GMD, Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines.

UNIT-III

Transmission line theory : Introduction, short transmission line, medium transmission line, evaluation of A,B,C,D Constants, Surge Impedance Loading of Long Lines, Ferranti effect.

UNIT-IV

Insulators: Introduction-Types of Insulators-Potential Distribution over a String of Insulators-Methods Of Equalizing The Potential, String Efficiency.

Corona: Introduction-Disruptive Critical Voltages- Factors Affecting Corona Loss-Methods Of Reducing Corona Loss-Disadvantages Of Corona-Interference Between Power And Communication Lines.

UNIT-V

Underground cables Types of cables, grading concepts, Capacitance of three core belted type cable. Cable sizing.

Substation practice: Classification of substations, layout, bus bar arrangements, elementary concepts of AC and DC distribution.

Text Books:

1. J B Gupta "A Course in Power Systems" S. K. Kataria& sons, 15th Edition, 2013.
2. C. L. Wadhwa "Electrical Power Systems" New Age International (P) Limited Publishers, 6th Edition, 2010.

Reference Books:

1. J. Nagarath and D.P Kothari "Power System Engineering" Tata Mc Graw-Hill, 2nd Edition, 2008.
2. Soni, Gupta and Bhatnagar "A Course in Electric Power" Dhanpat Rai & Sons.
3. S. N. Singh "Electric Power Generation, Transmission & Distribution" PrenticeHall India.

Course Outcome-Program Outcome- Program Specific Outcomes (CO-PO-PSO) Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**
CO2	**L**	**H**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**H**	**L**	**-**
CO3	**H**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**
CO4	**L**	**M**	**H**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**L**	**H**	**-**
CO5	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**

Minor-4

20EETM04: CONTROL SYSTEMS

Credits – 4 **Sessional Marks: 30**

L: T: P:: 3:1:0 **University Exam Marks: 70**

Course Objectives:

1 Make the students learn about the mathematical modelling, feedback control System.
2. Impart Knowledge on State Space Analysis.
3. Familiarized the Concepts of stability analysis in Time and Frequency domains.
4. Study about Different types of Controllers.

Course Outcomes:

On successful completion of the course, students will be able to

CO1. Demonstrate knowledge on the concepts of open and closed loop control systems.
CO2. Understand the Concepts of stability analysis in Time Domain.
CO3. Analyze the Stability analysis in Frequency Domain.
CO4. Explore different types of controllers.
CO5. Develop and analyze state space models for electrical and mechanical systems.

UNIT I

Introduction:

Introduction to control systems – Control theory concepts - Open loop and feedback control systems – Mathematical modelling of control systems – Analysis of control systems using Laplace transforms – Block diagram reduction techniques – Signal flow graphs.

UNIT II

Time Response Analysis:

Time Response Analysis - Analysis of transient and steady state behaviour of control systems. Standard test signals – Time response of first order and higher order systems, design specification of second-order system based on time response. Steady state errors – Error criterion.

UNIT III

System Stability and Root – Locus:

Stability concepts – Conditions for stability – Routh- Hurwitz stability criteria - Root locus concepts - Construction of root loci, Root contours, Compensation design of P, PI, PD & PID controllers, Lead and Lag Compensators.

UNIT IV

Frequency Response Analysis:

Frequency response specification – Time and frequency response correlation – Bode plot – Gain margin – Phase margin -polar plot -All pass minimum phase and non-minimum phase systems–. Nyquist stability criterion

UNIT V

State Space Analysis of Linear Continuous Systems:

Introduction - State space representation using physical variables – Phase variables and canonical variables – Derivation of transfer function from state model – Solving the time invariant state equation – State transition Matrix – Its properties and computation. Concept of controllability and Observability.

Text Books:

1. I.J.Nagrath and M.Gopal ,"Control Systems Engineering",5th edition, New Age International (P) Limited, New Delhi, 2007.
2. K. Ogata,"Modern control engineering", 4th edition, Pearson Education, 2004.

Reference Books:

1. Norman S. Nise, "Control System Engineering", 4th edition, Wiley Student Edition, 2008.

2. B.C.Kuo, "Automatic control systems", 8th edition, Wiley Student Edition, 2008.

3. Ashfaq Husain, haroon Ashfaq," Control Systems", 1st edition, Dhanpat Rai&Co, 2011.

Course Outcome-Program Outcome- Program Specific Outcomes (CO-PO-PSO) Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	-	-	-	-	-	-	-	-	M	-	-	-	-	H
CO2	H	M	-	-	-	-	M	-	-	M	-	-	-	-	H
CO3	L	H	M	-	-	-	-	-	-	M	-	-	L	H	-
CO4	H	H	L	-	-	-	-	-	-	M	-	-	-	-	H
CO5	M	M	H	-	-	-	-	-	-	M	-	-	L	H	-

Minor-5

20EETM05: POWER ELECTRONICS

Credits – 4 **Sessional Marks: 30**

L: T: P:: 3:1:0 **University Exam Marks: 70**

Course objectives

1. To study the characteristics of various power semiconductor devices and to design firing circuits for SCR.
2. To learn the operation of single phase and three phase controlled rectifiers with R, RL, RLE loads and effect of source inductance and freewheeling diode on converter performance.
3. To know about control strategies of Choppers and their performance
4. To impart knowledge on line commutated converters, Cycloconverter and ac voltage regulators.

Course outcomes

At the end of the course the student will be able to

CO1. Describe the characteristics of various power semiconductor devices and analyze the Static and dynamic characteristics of SCR's and Design firing circuits for SCR

CO2. Understand the operation of single phase and three phase converters.

CO3. Analyze the operation of different types of DC-DC converters and control strategies.

CO4. Explain the operation of single and three phase inverters and application of PWM techniques for voltage Control.

CO5. Discuss about the operation of AC voltage controllers and Cyclo-converters.

UNIT I

Power semi conductor devices: Diode , Thyristor, MOSFET, IGBT : V-I characteristics; dynamic characteristics of SCR, Firing circuit for Thyristor– Series and parallel operation of SCR's, Need for Equalizing Network and Equalizing Network design – Protection circuits – Design of Snubber circuit – Class A,B,C,D,E types of commutation circuits.

UNIT II

Phase controlled Rectifiers: Principles of phase control – Half-wave and full- wave controlled rectifiers with resistive, inductive load – Freewheeling diode operation – Bridge rectifiers – Single phase and three phase Rectifiers with inductive load – Half and fully controlled rectifiers – freewheeling diode operation – Effect of source inductance –Dual converter – circulating and non-circulating current mode of operation.

UNIT III

Choppers: Principles of operation – Principles of operation – control strategies, constant and variable frequency system, current limit control – Types of chopper circuits – Type-A, Type B and Type E chopper circuits Morgan chopper Jone's chopper – step-up and multiphase chopper circuits – load commutated chopper.

UNIT IV

Inverters: Classification – series and parallel inverters improved series inverters – Bridge inverters – Commutation circuits – current and voltage commutation circuits – single phase and three phase inverters – output waveform control – Mc Murray Inverter – Introduction to current source inverters.

UNIT V

Cyclo-converters: Principle of operation – single phase step-up and step down cyclo converters – Three-phase half-wave Cyclo converters – output voltage equation – circulation and non-circulating current mode of operation – Load commutated Cyclo converter. Introduction to AC voltage controller.

Text Books

1. Dr.P.S.Bimbhra, "Power Electronics", 2nd edition, Khanna publishers, 2006.
2. M.D.Singh and K.B.Khanchandani,"Power Electronics", 2nd edition, Tata McGraw Hill publishers, 2017.

References Books

1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices, and Applications", 4th edition Pearson education, 2017.
2. V. Subrahmanyam," A Text book of Power Electronics Power Electronics: Devices, Converters, Application**"** New age Publication, 2018.
3. P C Sen,"Power Electronics", Tata McGraw Hill publishers, 2017.

Course Outcome-Program Outcome- Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**H**	**M**	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**
CO2	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**
CO3	**-**	**H**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**L**	**H**	**-**
CO4	**H**	**M**	**-**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**
CO5	**H**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**H**