SEMESTER IV

S.No.	CODE	COURSE OF STUDY	L	T	P	C
1.	MA202	Mathematics - IV	3	0	0	3
2.	EE202	DC Machines and Transformers	3	1	0	4
3.	EE204	AC Machines	3	1	0	4
4.	EE206	Transmission and Distribution of Electrical Energy	3	0	0	3
5.	EE208	Electron Devices	3	0	0	3
6.	CE232	Mechanics of Solids, Fluids and Fluid Machinery	3	0	0	3
7.	EE210	Electrical Machines Laboratory	0	0	3	2
8.	EE212	Electron Devices Laboratory	0	0	3	2
		Total	**18**	**2**	**6**	**24**

SEMESTER IV

MA202 MATHEMATICS – IV

Course Objectives

The objective of this subject is to expose student to understand the basic importance of numerical methods to tackle the problems which cannot be solved analytically. It also focuses the probability theory and its applications in science and Engineering.

Unit I: Statistics and Probability: Probability laws – Addition and Multiplication theorems on probability - Baye's theorem – Expectation, Moments and Moment generating function of Discrete and continuous distributions, Binomial, Poisson and Normal distributions, fitting these distributions to the given data.

Unit II: Testing of Hypothesis - Z-test for single mean and difference of means, single proportion and difference of proportions - t-test for single mean and difference of means, F-test for comparison of variances. Chi-square test for goodness of fit – Correlation, regression.

Unit III: Numerical Analysis: Lagrange interpolation, forward, backward and central differences, Newton's forward and backward interpolation formulae, Numerical differentiation at the tabulated points with forward backward and central differences.

Unit IV: Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method, Euler's method, modified Euler's method, Runge-Kutta

method of 4th orders for solving first order ordinary differential equations, Numerical solution of algebraic and transcendental equations by Regula-Falsi method, Newton - Raphson's method. Curve fitting by the method of least squares. Fitting of Straight line, Second degree parabola.

Unit V: Series Solution : Classification of singularities of an ordinary differential equation - Series solution- Method of Frobenius - indicial equation - examples. Bessel and Legendre functions: Bessel function of first kind Recurrence formulae Generating function Orthogonality of Bessel functions Legendre polynomial rodrigue's formula - Generating function Recurrence formula - Orthogonality of Legendre polynomials.

Text Books

1. Gupta.S.C and Kapoor.V.K, "Fundamentals of Mathematical Statistics", Sultan Chand, 2011.
2. Erwyn Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, 2011.

Reference Book

1. Grewal.B.S, "Higher Engineering Mathematics", Khanna Publications, 42nd Edition, 2012.

Course Outcomes

Students will have an ability to apply knowledge of mathematics and science in Electrical engineering problems.

EE202 DC MACHINES AND TRANSFORMERS

Course Objectives

The objective of this course is

- To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- To introduce the principles of electromechanical energy conversion in singly and multiply excited systems.
- To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To study the working principles of DC machines as Generator and Motor, types, determination of their no-load/load characteristics, starting and methods of speed control of motors.
- To estimate the various losses taking place in D.C. machines and to study the different testing methods.

Unit I: Principle of Energy conversion – Basic magnetic circuit analysis - Faradays law of Electromagnetic induction – singly and doubly Excited magnetic field systems – Torque production in rotating machines and general analysis of electro mechanical system.

Unit II: DC Generator – construction - lap and wave windings, classification, principle of operation, types – EMF equation – Characteristics - commutation - Armature reaction, Equivalent circuit, Parallel operation of Generators.

Unit III: DC motor – principle of operation, types – Torque equation – Electrical and Mechanical characteristics – starting – speed control – Various testing – Braking, Parallel operation of motors. - Losses in DC machines, Efficiency - Starting, speed control and braking of DC motors – BLDC

Unit IV: Transformers – Basic Theory, Ideal transformer - Magnetizing current waveform - Construction of transformers, principle of operation, EMF equation, Practical single phase transformer, types, phasor diagram Equivalent circuit - Losses in a transformer- Efficiency, condition for maximum efficiency and all day efficiency, Voltage regulation – Auto transformer, Instrument Transformers – Current Transformer, Potential Transformer – Capacitive Voltage transformer

Unit V: Three phase transformer - Polyphase connections. - Scott connected transformer - Scott connection – all day efficiency - Sumpner's test - parallel operation of transformer-vector Grouping, Transformer windings - Tap-changing and voltage control.

Text Books

1. Nagrath.I.J and Kothari.D.P, "Electrical Machines", Tata McGraw Hill Education Private Limited, New Delhi, 4th Edition, 2010.
2. Sawhney.A.K, " A course in Electrical machines Design", Dhanpat Rai and Sons , New Delhi, 5th Edition, 1990.

Reference Books

1. Cotton.H, "Electrical Technology", CBS Publishers, 7th Edition, 2005.

Course Outcomes

1. Students will know the constructional details ,working principle, control and applications of DC Machines
2. Students will know the constructional details and working principle of transformers.
3. Students will acquire the ability to :

i. Design and conduct experiments, as well as to identify, formulate and solve machine related problems.
ii. Analyze the performance of the DC Machines under various operating conditions using their various characteristics.
iii. Evaluate the performance of Transformers using phasor diagrams and equivalent circuits.
iv. Discuss electric and magnetic field interactions in electromechanical devices and machines

EE204 AC MACHINES

Course Objectives

To expose the students to the concepts of various types of AC Electrical Machines and fractional KW motors

Unit I: Concept of rotating flux - Poly phase Induction motors (machine)- construction, types, principle of operation, slip - equivalent circuit - power flow diagram, slip-torque characteristics, circle diagram - starting and speed control - testing of induction motor, crawling and cogging, applications, induction generators - applications.

Unit II: Synchronous motors - construction, principle and types - starting methods - phasor diagrams -V and inverted V curves – Hunting.

Unit III: Alternators - construction, classification, application, non salient pole synchronous machine: working principle, EMF equation, distribution factor and pitch factor, armature reaction, equivalent circuit, phasor diagram, calculation of synchronous reactance, performance indices, isolated and parallel operation of synchronous generator, testing, power angle characteristics, V-curve , parallel operation, load sharing, starting of synchronous motor, hunting, short circuit transient in synchronous machine. Salient pole synchronous machine: two reaction theory, determination of X_d and X_q.

Unit IV: Single phase induction motor: construction, principle and types - double revolving field theory - development of equivalent circuit based on double revolving field theory, torque-slip characteristic, performance analysis; Starting by phase splitting; selection of capacitor value for starting and running conditions. Permanent magnet brushless motors - construction, principle and types - phasor diagram, Torque Equation.

Unit V: Single Phase Fractional Kilowatt Motors - Introduction - Single phase synchronous motors – reluctance motor (hysteresis motor) - Commutator type single-phase motors – Repulsion Induction motor, shaded pole motors, AC series motor and universal motors- Introduction to servo- motors and stepper motors – Concept of micro motors.

Text Books

1. Nagrath.I.J and Kothari.D.P, "Electrical Machines", Tata McGraw Hill Education Private Limited, New Delhi, 4th Edition, 2010.
2. Irving L.Kosow, "Electric Machinery and Transformers", Prentice Hall of India Private Ltd., New Delhi, 2nd Edition, Reprint 2007.
3. Sawhney.A.K, " A course in Electrical machines Design", Dhanpat Rai and Sons , New Delhi, 5th Edition, 1990.

Reference Books

1. Say M.G, "Performance and Design of Alternating Machines", CBS Publishers and Distributors, New Delhi, Reprint 2005.
2. Stephen J.Chapman, "Electric Machinery Fundamentals", Tata McGraw Hill International Edition, New Delhi, 4th Edition, 2005.

Course Outcomes

1. Students will be aware of the constructional details, principle of operation of AC Machines and fractional kw motors.
2. Students will be able to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.

EE206 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY

Course Objectives

To impart knowledge

1. On the basics of transmission and distribution of power system.
2. For estimation of sag and tension.
3. For the Calculation of R, L and C of transmission line.
4. About Corona and its effects
5. For evaluating the performance of transmission line.
6. About insulators and cables and their grading.
7. Regarding bus bar arrangements in substation.

Unit I: Transmission line parameters – resistance, inductance and capacitance calculations - single phase and three phase lines – double circuit line - effect of earth on transmission line capacitance.

Unit II: Performance of transmission lines – regulation and efficiency – tuned power lines power flow through a transmission line – power circle diagrams, formation of corona – critical voltages – effect on line performance.

Unit III: Mechanical design of overhead lines – line supports – insulators - voltage distribution in suspension insulators – string efficiency - testing of insulators stress and sag calculation – effects of wind and ice loading.

Unit IV: Underground cables – comparison with overhead line – types of cables – insulation resistance – potential gradient – capacitance of single core and three core cables.

Unit V: Distribution systems – general aspects – Kelvin's Law, A.C. distribution – single phase and three phase - techniques of voltage control and power factor improvement, recent trends in transmission and distribution systems.

Text Books

1. Wadhwa.C.L, "Electrical Power systems", New Academic Science Limited Publishers, 2009.
2. Gupta.B.R, "Power System Analysis and Design", Chand Publishing, 2005.
3. Cotton.H, "Transmission and Distribution of Electrical Energy", ELBS, reprinted edition, 2006.

Reference Books

1. Singh.S.N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Private Limited, New Delhi, 2nd edition, 2008.
2. Kothari.D.P and Nagarath.I.J, "Power System Engineering", Tata McGraw-Hill Publishing Company limited, New Delhi, 2nd edition, 2007.
3. Luces M.Fualkenberry and Walter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 1st edition, 2007.

Course Outcomes:

At the end of the course students will be able to

1. Calculate the sag for transmission lines.
2. Design the transmission line parameters for its specific performance.
3. Distinguish insulators and determine the string efficiency of insulator string and suggest methods for its improvement.
4. Predict the performance parameters and grading of cable
5. Select bus-bar arrangements for a substation
6. Estimate the voltage drop in distributors.

EE208 ELECTRON DEVICES

Course Objectives:

The objective of this course is

- To understand the basic physical structure, principles of operation, electrical

characteristics and circuit models of the most important semiconductor devices, and to be able to use this knowledge to analyze and design basic electronic application circuits.

- To extend the understanding of how electronic circuits and their functions fit into larger electronic systems.

Unit I: Semi Conductors- charge carriers, electrons and holes - energy band diagram – mobility - intrinsic and extrinsic semi conductors - Hall effect.

Unit II: Diodes - PN junction - current equation - junction capacitance - breakdown characteristics, Zener, tunnel, Schottky diodes.

Unit III: Bipolar junction transistors - Low frequency and high frequency equivalent circuits – analysis of CB, CE, CC amplifier configurations.

Unit IV: Uni polar devices - FET, MOSFET, UJT and Opto-Electronic devices - theory and characteristics.

Unit V: Modern devices – SCR – Thyristor – GTO – IGBT – IGCT – Diac and Triac**.**

Text Books

1. Millman and Halkias, "Electronic Devices and Circuits", Tata McGraw Hill 3rd Edition, 2010.
2. David A.Bell, "Electronic Devices and Circuits", 3rd Edition, Prentice Hall of India, 2008.
3. Floyd, "Electron devices", Pearson Asia 5th Edition, 2001.

Reference Books

1. Allen Mottershead, "Electronic Devices and Circuits - An Introduction", Prentice Hall of India, 18th Reprint, 2006.

Course Outcomes:

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

1. Analyze the different types of diodes, operation and its characteristics
2. Design and analyze the DC bias circuitry of BJT and FET
3. Design circuits using the transistors, diodes and oscillators

CE232 MECHANICS OF SOLIDS, FLUIDS AND FLUID MACHINES

Course Objectives

The objective of this course is

- To learn the basic concepts of simple stress strain in composite bars
- To learn the bending and shear forcebehavior for beams and
- To learn the buckling behavior of columns

- To learn about the fluid pressure measurement devices
- To learn about the various losses presented in the fluid flow
- To learn the fundamental working behavior of centrifugal pumps are turbines

Unit I: Stress – Strain – Elastic constants – Stress in Composite bars – Beams – Types – Shear force and bending moment diagrams for simply supported and overhanging

Unit II: Columns - Long column – Euler's Theory – Short column – Empirical formulae – Torison of Circular shafts – Hollow Shafts – Power transmission.

Unit III: Vapour Pressure – Pressure at a point its variation – Measurement with Piezometer, manometers and gauges.

Unit IV: Continuity equation in one dimension – Bernoulli's equation – Venturimeters and Orificie meters – Flow through pipes – Laminar, Turbulent flow - Major losses.

Unit V: Pumps – General principles of displacement and Centrifugal pumps – Efficiency and Performance Curves of Pumps – Cavitations in Pumps – Turbines – Efficiency – Governing of turbines.

Text Books

1. Ramamirtham, S., "Strength of Materials", Dhanpat Rai and Sons, New Delhi, 2011.
2. Rajput , R.K., "Strength of Materials" , S.Chand and Co Ltd., New Delhi, 4th Edition, 2007.

Reference Book

1. Nagarathnam.S, "Fluid Mechanics", Khanna Publishers, New Delhi, 1989.

Course Outcomes

On completion of this course the students will be able to:

1. To determine the amount of stress and strain at different key points of axially loaded composite bars
2. To draw the shear force& bending moment diagrams ofsimply supported & over hanging beams
3. To calculate the critical buckling load of columns made of different materials
4. To calculate the pressure distribution of fluids with in pressure vessels
5. To calculate the major and minor losses of various fluid flows
6. To carry out the performance analysis and to calculate the efficiency of pumps and turbines

EE210 ELECTRICAL MACHINES LABORATORY

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Load test on DC shunt motor
4. Speed control of DC shunt motors
5. Swinburne's test
6. Open circuit and short circuit test on single phase transformer
7. Separation of no load losses in a single phase transformer
8. Sumpner's test
9. Load test on single phase transformer
10. Parallel operation of single phase transformer
11. Load test on three phase induction motor.
12. No load and blocked rotor test on three phase induction motor.
13. Load test on grid connected induction generator.
14. Load test on self –excited induction generator.
15. Load test on single phase induction motor.
16. Regulation of three phase alternator by EMF and MMF methods.
17. Load test on three phase alternator.
18. Synchronization of three phase alternator with infinite bus bar.
19. V and inverted V-curves of synchronous motor.
20. Study of induction motor starters.

EE212 ELECTRON DEVICES LABORATORY

1. Half wave and full wave rectifiers
2. Bridge Rectifier
3. Volt-ampere characteristics of rectifier diode and zener diodes
4. Characteristics of UJT
5. Characteristics of FET
6. Clipping and clamping circuits
7. Transistor characteristics - CE
8. Transistor characteristics – CB