**K.S.R.M.COLLEGE OF ENGINGINEERING, KADAPA**

**DEPARTMENT OF EEE (AUTONOMOUS)**

**B.TECH VII SEM - SYLLABUS**

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1525701 | PJ | Management Science | 3 | 1 | 0 | 30 | 70 | 3 |

**Objectives**

1. Provide a basic understanding of management science including analytical problem solving and communications skills.
2. Prepare for practice in a field that sees rapid changes in tools, problems and opportunities.
3. Prepare for graduate study and self-development over an entire career.
4. Provide ability to use the techniques, skills and modern engineering tools necessary for engineering practices.
5. The broad education necessary to understand the impact of engineering solutions in a global and societal context.
6. Background necessary for admission to top professional graduate engineering or business programs.

**UNIT- I**

**Introduction to Management:** Concept of Management-Administration, Organization-Functions of Management, Evolution of Management Thought, managerial objectives and social responsibilities of Management. Organization: Principles of Organization-Types of mechanistic and organic structures of organizations.

**UNIT – II**

**Strategic Management:** Mission, Goals, Objectives and Programmes, Elements of Corporate Planning Process- SWOT Analysis-Strategy Formulation and Implementation. Plant location and Plant Layout concepts-Production control.

**UNIT – III**

**HRM and Inventory Management:** Human Resource Management - Personnel Management and Industrial Relations (PMIR)-Basic functions of Personnel Management, Job Evaluation and Merit Rating-Incentive plans.

**Inventory Management**: Need for Inventory Control; EOQ, ABC Analysis, Purchase Procedure, Maintaining Store Records.

**UNIT-IV**

**Operations Management:** Productivity- Job, Batch and Mass Production-Work Study-Basic procedure involved in Method Study and Work Measurement- Statistical Quality Control: *c* chart, *p* chart, R chart, Acceptance sampling, Deming's contribution to Quality.

**UNIT-V**

**Project Management:** Network Analysis to project management- PERT/CPM- Application of network techniques to engineering problems- Cost Analysis-Project Crashing.

**Text Books**

1. Aryasri: Management Science, TMH, 2008.

**Reference Books**

1. Koontz& Weihrich: Essentials of Management,6/e,TMH,2005
2. Kanishka Bedi: Production and Operations Management, Oxford University Press, 2004
3. Parnell: Strategic Management, Biztantra, 2003.
4. LS Srinath: PERT/CPM, Affiliated East-West Press, 2005

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502702 | PJ | Advanced Control Systems | 3 | 1 | 0 | 30 | 70 | 3 |

**Objective:**

This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability.

**UNIT – I**

**Linear System Design:** Introduction of compensating networks – Lead, Lag, lead – lag cascade compensation in time domain –P, PI and PID controllers design using Bode plot and root locus techniques.

**UNIT – II**

**State variable descriptions:** Concepts of State, State variables, State vector, State space model, representation in state variable form, phase variable representation – Diagonalization – Canonical variable representation.

**Controllability and Observability:** Definition of controllability – Controllability tests for continuous Linear time Invariant systems – Definition of Observability – Observability tests for continuous Linear time Invariant systems.

**UNIT – III**

**Time Response of Linear System:** Introduction – Solution of state equations – State Transition matrix – Pole placement by state feedback – Full order and reduced order observers.

**UNIT – IV**

**Non-Linear Systems:** Introduction – common physical non-linearities, Singular points, Basic concepts of phase plane method, construction of phase trajectories by phase plane method. Basic concepts and derivation of describing functions. Stability analysis by describing function method.

**UNIT – V**

**Stability:** Introduction – Equilibrium points – Stability concepts and definitions – Stability in the sense of Liapunov stability of linear system – Methods of constructing Liapunov functions for Non – linear system – Krasovskii's method – Variable gradient method.

**Text Books:**


1. Modern Control System Theory by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Control System Engineering by I. J. Nagarath and M. Gopal, New Age International (P) Ltd.


**Reference Books:**


1. Modern Control Engineering by K. Ogata, Prentice Hall of India, 3rd Edition, 1998.
2. Systems and Control by Stainslaw, H. Zak, Oxford Press, 2003.
3. Digital Control and State Variable Methods by M. Gopal, TMH, 1997.


**Course Outcomes:**

On successful completion of this course, student will be able to

1. Gain knowledge on design of compensators

2. Gain knowledge on State space representation, Controllability, observability and pole placement non-linear system
3. Analyze stability of a non-linear system using describing functions and phase plane analysis.
4. Evaluate controllability, observability of linear systems, stability of systems using describing functions and liapunov stability criterion.

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502703 | PJ | High Voltage Dc Transmission | 3 | 1 | 0 | 30 | 70 | 3 |

**Objective**: This subject gives the fundamental concepts of High voltage direct current. It mainly concentrates on converter configuration and analysis for the application of high voltage transmission system.

**UNIT-I**

**D. C. Power Transmission Technology:** Introduction- Comparison of AC & DC transmission, Converter station, Description of DC Transmission systems, Choice of voltage level, Modern trends in DC transmission.

**UNIT-II**

**Analysis of HVDC Converters:** Pulse number, Choice of converter configuration, valve rating, Transformer, Simplified analysis of graetz-circuit with and without overlap, Rectifier and Inverter waveforms, Converter bridge characteristics.

**UNIT – III**

**Converter and HVDC System Control:** Principle of DC link control, Converter control characteristics, System and control hierarchy, Firing angle control, Converter and excitation angle control, Starting and stopping of DC Link , Power Control, Higher level Controllers.

**UNIT – IV**

**Converter Faults:** Protection against over currents, over voltages in a converter station, Surge arresters, Protection against over voltages. Smoothing reactor, DC Line, Transient over voltages in DC line, Protection of DC Line, DC breakers.

**UNIT – V**

**Reactive Power Requirements in Steady State:** Sources of reactive power, Static var systems, generation of Harmonies, Design of AC filters, DC filters, Carrier frequency and RI Noise.

**Text Books:**


1. High Voltage Direct Current Transmission by J. Arilliga 2nd edition, IEE Power and Energy Series.
2. High Voltage Direct Current Transmission by K. R. Padiyar, Wiley Eastern Ltd.,1993.
3. Direct current transmission by E. W. Kimbark, Wiley Inter Science New York 1971.


**Reference Books**:


1. EHVAC, HVDC Transmission and Distribution Engineering by S. Rao, Khanna Publishers, 2001.
2. Power Transmission by Direct Current by E. Uhlamann, Springer – Verlag, Berlin, 1975.


**Course Outcomes:**

On successful completion of this course, student will be able to

1. Gain knowledge on Converter Circuits.
2. analyze the applications of high voltage transmission system
3. Analyze the protection system for HVDC transmission
4. Design the filters for DC transmission.

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502704 | PJ | Switch Gear and Protection | 3 | 1 | 0 | 30 | 70 | 3 |

**UNIT-I**

**Over Voltages in Power Systems:** Cause of over voltages, protection against lightning over voltages, ground wires, counter poises, surge absorbers and surge diverters ,lightning arrestors(valve type),ratings of Lightning arrestors, insulation co-ordination, neutral earthing-types.

**UNIT-II**

**Circuit Breakers:** Elementary principles of arc interruption, restriking and recovery voltages, average and maximum RRRV, numerical problems. Current chopping and resistance switching-circuit breaker ratings, auto re-closure and problems. Description and operation of minimum oil circuit breakers, air break circuit breakers, vaccum circuit breakers and sulphur hex fluoride circuit breakers.

**UNIT-III**

**Protective Relays:** Basic requirements of a relays, relay terminology, types of relays, electromagnetic relays (attraction type and induction type). Construction and operation of non-directional and directional over current relays, universal torque equation, operating characteristics of impedance, reactance and admittance relays. Principle and operation of differential and percentage differential relays.

Static Relays: Advantages and Dis-advantages, amplitude comparators and phase comparators.

**UNIT-IV**

**Protection of Generators:** protection of generators against stator faults, rotor faults and abnormal running conditions, restricted earth fault protection and inter turn fault protection, numerical problems on percentage winding unprotected.

Protection of transformers: percentage differential protection of transformers, numerical problems on design of CT's ratio, Buchholtz relay.

**UNIT-V**

**Protection of Feeders and Lines:** Protection of feeders (radial and ring main) using over current relays, protection of transmission lines by three zone protection using distance relays, carrier current protection and protection of bus-bars.

**Text Books:**


1. Power System Protection and Switch Gear by Badriram & D. N. Vishwakarma, TMH publishing Company Ltd., 1995.
2. Electrical Power Systems by C. L. Wadhwa, New Age International (P) Limited, 3rd Edition.
3. Power System Protection & Switch Gear by B. Ravindranath & M. Chander, Wiley Eastern Ltd.
4. Switch Gear and Protection by Sunil. S. Rao, Khanna Publishers.

**Reference Books:**


1. Fundamentals of Power System Protection by Y. G. Paithanakar and S. R. Bhide, PHI, 2nd Edition.
2. Transmission Network Protection by Y. G. Paithankar, Taylor and Francis, 2009.
3. Power System Protection and Switch Gear by Bhuvanesh Ozq, TMH, 2010.
4. Electrical Power System Protection by C. Christopoulos and A. Wright, Springer International Edition, 2nd Edition.


**Course Outcomes:**

On successful completion of this course, student will be able to

1. Gain knowledge on operation of various protective devices.
2. Analyze fault current levels for different faults, operating aspects of protective devices
3. Design proper protection scheme for different power system components
4. Acquire skills in evaluating operating parameters of various protecting devices

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502705 | PJ | Electrical Distribution Systems | 3 | 1 | 0 | 30 | 70 | 3 |

**Objective**: This course mainly focuses the distribution end of the power system in which the characteristics of load, classification of distribution systems, substations, automation of the distribution systems are introduced.

**UNIT I**

**Load Modeling and Characteristics:** Introduction to Distribution Systems, Load Modeling and Characteristics. Coincidence Factor, Contribution Factor Loss Factor - Relationship between the Load Factor and Loss Factor. Classification of Loads (Residential, Commercial, Agricultural and Industrial) and Their Characteristics.

**UNIT II**

**Classification of Distribution Systems:** Classification of Distribution Systems - Comparison of DC Vs AC–comparison of Under-Ground Vs Over - Head Distribution Systems- Requirements and Design Features of Distribution Systems-

Design Considerations of Distribution Feeders: Radial and Loop Types of Primary Feeders,-Voltage Levels, Feeder Loading, Basic Design Practice of the Secondary Distribution System.

Voltage Drop & Current Calculations (Numerical Problems) In D.C. Distributors (Feeder with one end and both ends only)

**UNIT III**

**Substations:** Location of Substations: Rating of Distribution Substation, Service Area within Primary Feeders. Benefits Derived Through Optimal Location of Substations. Classification of Substations: Air Insulated Substations - Indoor & Outdoor Substations: Substations Layout Showing the Location of All the Substation Equipment. Bus Bar Arrangements in the Sub-Stations With Relevant Diagrams.

**UNIT IV**

**Power Factor Improvement:** Voltage Drop and Power-Loss Calculations: Derivation for Voltage Drop and Power Loss in Lines, Manual Methods of Solution for Radial Networks, Three Phase Balanced Primary Lines.

Causes of Low P. F -Methods of Improving P. F-Phase Advancing and Generation of Reactive KVAR Using Static Capacitors-Most Economical P.F. for Constant KW Load and Constant KVA Type Loads, Numerical Problems.

**UNIT V**

**Distribution Automation:** Distribution Automation (DA) – Project Planning – Definitions – Communication – Sensors – Supervisory Control and Data Acquisition (SCADA) – Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR) – Automation Systems.

**Text Books:**

1. Electric Power Distribution System, Engineering by Turan Gonen, Mc Graw-hill Book Company, 1986.
2. Electric Power Distribution by A. S. Pabla, Tata Mc Graw-hill Publishing Company, 4th edition, 1997.

**Reference Books:**

1. Electric Power Distribution Automation by Dr. M. K. Khedkar and Dr. G. M. Dhole, University Science Press, 2010.
2. Electrical Power Distribution Systems by V. Kamaraju, Jain Book Depot. 2012.
3. Electrical Power Systems for Industrial Plants by Kamalesh Das, JAICO Publishing House, 2008.
4. Hand Book of Electric Power Distribution by G. Ramamurthy, 2nd Edition, Universities Press, 2009.

**Course Outcomes:**

On successful completion of this course, student will be able to

1. Gain knowledge on distribution system and its configuration, different types of loads and distribution feeders.
2. Analyze different feeder configurations, bus bar arrangements in substations

3. Design proper rating of capacitor to improve power factor.

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502707 | PJ | POWER QUALITY | 3 | 1 | 0 | 30 | 70 | 3 |

# (CBCC - I)

**OBJECTIVES:** The objectives of this course include:

- To know about introduction on power quality issues.
- To learn about voltage disturbances and power transients that are occurring in power systems.
- To know the concept of harmonics in the system and their effect on different power system equipment.
- To know about different power quality measuring and monitoring concepts.

**UNIT I INTRODUCTION**

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude Versus Duration Plot - Power Quality Standards ( IEEE & IEC) - Responsibilities of The Suppliers and Users of Electric Power-CBEMA and ITIC Curves.

**UNIT II TRANSIENTS, SHORT DURATION AND LONG DURATION VARIATIONS**

Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality Disturbances- Principles of Regulating the Voltage-Conventional Devices for Voltage Regulation.

**UNIT III FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS**

Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources From Commercial Loads, Harmonic Sources From Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

**UNIT-IV POWER QUALITY MONITORING**

Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power

Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

**UNITV POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES**

Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner (UPQC)-Principle of Operation Only.

**OUTCOMES:**

After completion of the course the student will able to:

- Understand the different power quality problems in the power system.
- Know about voltage variations and over voltage transients in the system and also know about the protection of over voltages.
- Under stand the effect of harmonics in the system and about the equipment that are effected from the harmonics.
- Know the concepts on measuring and monitoring issues of power quality.

**TEXT BOOKS:**


1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd., 2008.
2. Power quality, C. Sankaran, CRC Press, 2002.


**REFERENCE BOOKS:**


1. Understanding Power quality problems, Math H. J. Bollen IEEE Press, 2007.
2. Power quality enhancement using custom power devices, Arindam Ghosh, Gerard Ledwich, Kluwer academic publishers, 2002.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2010.

K.S.R.M.COLLEGE OF ENGINEERING(AUTONOMOUS),KADAPA

Department of Electrical and Electronics Engineering

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502801 | PJ | Utilization of Electrical Power | 3 | 1 | 0 | 30 | 70 | 3 |

**Objectives:**

It deals with the illumination, Electrical heating, Welding, Electrolytic Process and Electric Traction.

**UNIT – I**

**Illumination**: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light, discharge lamps, MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes- Basic principles of light control- Types of lighting schemes -factory lighting, street lighting and flood lighting.

**UNIT-II**

**Electric Heating & Welding:** Advantages and methods of electric heating - types and applications of electric heating equipment- Resistance ovens-induction heating –dielectric heating-Electric welding –resistance welding and arc welding techniques - arc furnaces.

**UNIT –III**

**Electric Drives**: Types of Electric drives, Choice of motor, starting and running characteristics, Speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

**UNIT –IV**

**Systems of Electric Traction and Track Electrification:** Review of existing electric traction systems in India. Special features of traction motors, methods of electric braking – plugging, rheostatic braking and regenerative braking.

**UNIT –V**

**Mechanism of Train Movement**: Speed-time curves for different services – Trapezoidal and quadrilateral speed time curves – Calculations of tractive effort, power, specific energy consumption for a given run, effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesion.

**Text Books:**


1. Utilization of Electric energy by E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. Art & Science of Utilization of Electrical Energy by H. Partab, DhanpatRai& Co, 2004.


**Reference Books:**


1. Generation, Distribution and Utilization of Electrical energy by C. L. Wadhwa, New Age International (P) Limited, 1997.

2. Utilization of Electrical Power including Electric Drives and Electric Traction by N. V. Suryanarayana, New Age International (P) Limited, 1996.

**Course Outcomes:**

On successful completion of this course, student will be able to

2. Gain knowledge on different types of electric drives, heating, welding and illumination
3. Analyze appropriate drive for the industrial purpose, proper illumination strategy for good lighting system, the traction system for better performance
4. design illumination system for proper lighting.
5. Acquire skills in evaluating the illumination levels, performance of various electrical drives and traction effort.

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502802 | PJ | Flexible Ac Transmission Systems | 3 | 1 | 0 | 30 | 70 | 3 |

**Objective:**

This subject is an extension of previous power system courses. It deals with the detailed analysis of FACTS controllers which are the prime source of enhancement of electrical power generation and its utilities. Also concerns about the different types of FACTS controllers which are having significant applications in utility appliances and control systems.

**UNIT I**

**FACTS Concepts:** Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

**UNIT II**

**Voltage Source Converters:** Single & three phase full wave bridge Converters -transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

**UNIT III**

**Static Shunt Compensation:** Objectives of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping. Methods of controllable VAR generation, variable impedance type static VAR generators, switching converter type VAR generators, hybrid VAR generators.

**UNIT IV**

**SVC and STATCOM:** The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

**UNIT V**

**Static Series Compensators:** concept of series capacitive compensation, improvement of transient stability, power oscillation damping.

Functional requirements, GTO thyristor controlled Series Capacitors (GSC), Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) control schemes for GSC, TSSC and TCSC.

**Text Book:**

1. Concepts and Technology of Flexible AC Transmission Systems-Understanding FACTS by Narain G. Hingorani and Laszlo Gyuygyi, Standard Publishers Distributors, IEEE Press Publications, 1st Edition, 2001.

**Reference Text Books**:

1. Thyristorbaed FACTS Controllers for Electrical Transmission Systems by R. Mohan Mathur, Rajiv K. Varma, IEEE Press Series on Power Engineering, 2002.
2. Flexible AC Transmission Systems by Yong Hua Song and Alln T Johns, The Institute of Electrical Engineers, London, UK, 1999.

**Course Outcomes:**

On successful completion of this course, student will be able to

**1.** Gain knowledge on Operation of various different types of FACTS controllers, Protection of utility appliances and control systems

**2.** Analyze Understand the importance of controllable parameters and benefits of FACTS controllers

**3.** Analyze the functional operation and control of GCSC, TSSC and TCSC.

**4.** Acquire skills in evaluating FACTS devices are used in electrical power generation and its utilities.

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | CR |
|---|---|---|---|---|---|---|---|---|
| 1502803 | PJ | Electrical Machine Design | 3 | 1 | 0 | 30 | 70 | 3 |

**Objective:** This subject introduces the design specifications of Electrical Machines. It deals with basic design considerations of transformers, rotating machines - D.C. Machines, Three phase Induction motors Synchronous machines and Cooling of Machines.

***UNIT I***

The Design problem – Basic considerations, design specifications, ISI specifications, design constraints, specification of transformers, rotating machines.

Design of transformers – Types of transformer – core construction, output equation, principle of design of core, windings, yoke main dimensions (H & W) for single phase: core type, shell type. 3-phase – core type transformers estimation of no load current of transformer.

***UNIT II***

General concepts of rotating machines – Output equation of dc machines, ac machines, separation of D & L, choice of specific loadings.

Design of D.C machines – Choice of no. of poles, selection of no. of armature slots, choice of winding, estimation of conductor cross section of armature, design of field systems: tentative design of field winding of dc machines.

**UNIT III**

Design of 3-phase induction motor – Separation of D & L, ranges of Ampere conductors and Bav.

Stator design – Selection of no of stator slots, turns per phase, design of conductor cross section.

Rotor design - Selection of no of rotor slots, principles of design of squirrel cage rotor, design of slip ring rotor.

**UNIT IV**

Design of synchronous machines – Separation of D & L, choice of Ampere conductors &Bav - Short Circuit Ratio (SCR) and its significance.

Armature design – choice of no. of stator (Armature) slots, turns/phase, conductor cross section for both salient pole and cylindrical pole machines.

**UNIT V**

Heating & Cooling of electrical machines: Theory of Solid body heating, heating time constant- cooling time constant, elementary treatment of cooling and heating time curves.

Cooling of machines: Volume of coolant required, types of coolants, cooling methods of transformer, hydrogen cooling for rotating machines, transformer tank design.

**Text Books:**

1. Electrical machine design by A. K. Sawhney, Dhanpatrai& Sons.

2. Electrical System Design by M. K. Giridharan, I. K. International Publishing House Pvt. Ltd., 2011.
3. Design of Electrical Machines by V. N. Mittle and A. Mittal, Standard Publishers Distributors, 4th Edition, 1998.

**Reference Books:**

1. Principles of Electrical machine design by M. G. Say & Parker Smith.
**2.** Electrical machine design by Balbir Singh by Khanna Publishers.

**Course Outcomes:**

On successful completion of this course, student will be able to

1. Gain the knowledge on various design specifications of Electrical Machines.
2. Estimate the design specifications of DC machines, Transformers, Induction machines and synchronous machines.
3. Analyze the choice between various parameters like type of windings, no.poles, no.of slots etc
4. Anlyze the heating and cooling of electrical machines.

| Subject Code | Subject Category | Subject Title | L | T | P | IM | EM | C R |
|---|---|---|---|---|---|---|---|---|
| **1502806** | **PJ** | **Reliability Engineering & Applications to Power Systems** | **3** | **1** | **0** | **30** | **70** | **3** |

**(CBCC-IV)**

**UNIT I**

**Basic probability theory, Distribution & Network Modeling:** Basic probability theory-rules for combining probabilities of events, Bernoulli's trials, Probability Density and Distribution Functions, Binomial Distribution- Expected Value and Standard Deviation of Binomial Distribution. Analysis of Series, Parallel, Series – Parallel Networks, Complex Networks – Decomposition Method.

**UNIT II**

**Reliability Functions**: Reliability Functions – f(t), R(t), F(t), h(t) and their relationships – Exponential Distribution – Expected Value and Standard Deviation of Exponential Distribution – Bath – tub Curve – Reliability Analysis of Series – parallel Networks using Exponential Distribution – Reliability Measures. MTTF, MTTR, MTBF.

**UNIT III**

Markov Modeling – Markov Chains – Concept of STPM, Evaluations of Limiting State Probabilities – Markov Processes on Components Repairable System – Time Dependent Probability Evaluation using Laplace Transform Approach – Evaluation of Limiting State Probabilities using STPM – Two Component Reliability Models.

Frequency and Duration Concept – Evaluation of Frequency of Encountering State, Mean Cycle Time for One and Two Component Repairable Models – Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged States.

**UNIT IV**

**Generation System Reliability Analysis**: Reliability Model of a Generation System, Recursive Relation for Unit Addition and Removal, Load Modeling, Merging of Generation Load Model – Evaluation of Transition Rates for Merged State Model, Cumulative Probability and Cumulative Frequency of Failure Evaluation - LOLP, LOLE.

**UNIT V**

**Composite System Reliability Analysis**: System and Load Point Reliability Indices, Weather Effects on Transmission Lines, Weighted Average Rate and Markov Model.

Distribution System Reliability Analysis – Basic Techniques, Radial Networks, Evaluation of basic Reliability Indices, Performance Indices, Load Point and System Reliability Indices, Customer Oriented, Load and Energy Oriented Indices.

**Text Books:**

1. Reliability Evaluation of Engg. System – R. Billinton, R. N. Allan, Plenum Press, New York, Reprinted in India by B. S. Publications, 2006
2. Reliability Evaluation of Power Systems – R. Billinton, R. N. Allan, Plenum Press, New York, Reprinted in India by B. S. Publications, 2006.

**Course Outcomes:**

On successful completion of this course, student will be able to

1. Gain knowledge on elements of probability theory and probability distributions, network reduction techniques, markovmodeling, frequency and duration techniques, Generation and Load Modeling, Composite System and Distribution System Reliability Indices
2. Analyze the failure rate distributions, different network reduction techniques, methods for identifying critical components, merging of generation with load model, system and load point reliability indices, customer, load and energy oriented indices
3. Apply generation system reliability for calculating cumulative probability & frequency of various combined states distribution system reliability analysis for radial networks to assess the performance of customers.