ANDHRA UNIVERSITY
DEPARTMENT OF ELECTRICAL ENGINEERING
SCHEME AND SYLLABI
(With effect from 2025-2026 admitted batch onwards)
M.Tech (Power Systems and Automation)
Common with Dual Degree Course (B.TECH + M.TECH)

SEMESTER–I

Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS1.1	Advanced Power System Operation and Digital Protection	3	--	30	70	100	3
EEPS1.2	Modeling of Power Systems and FACTS Controllers	3	--	30	70	100	3
EEPS1.3	Professional Elective -I a) Optimization and Evolutionary Algorithms b) Artificial Intelligence and Machine Learning Techniques c) Electrical Distributed Systems and Automation.	3	--	30	70	100	3
EEPS1.4	Professional Elective -II a) Power Quality b) Power System Reliability c) IoT in Electrical Systems	3	--	30	70	100	3
EEPS1.5	Research Methodology and IPR	3	--	30	70	100	2
EEPS1.6	Audit Course– I: a) English for Research Paper Writing b) Disaster Management c) Sanskrit for Technical Knowledge d) Value Education	3	--	30	70	100	--
EEPS1.7	Intelligent Systems Laboratory	--	3	50	50	100	2
EEPS1.8	Power System Modeling and Simulation Lab	--	3	50	50	100	2
Total							**18**

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SEMESTER–II

Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS2.1	Automation in Power Systems	3	--	30	70	100	3
EEPS2.2	Power System Dynamics and Stability	3	--	30	70	100	3
EEPS2.3	Professional Elective-III a) Hybrid Electric Vehicles b) Energy Storage Systems c) Energy Auditing and Management	3	--	30	70	100	3
EEPS2.4	Professional Elective -IV (a) Power System Deregulation (b) Renewable Energy systems (c) Real Time Control of Power Systems	3	--	30	70	100	3
EEPS2.5	Audit Course–II: a) Constitution of India b) Pedagogy Studies c) Stress Management by Yoga d) Personality Development through Life Enlightenment Skills	3	--	30	70	100	--
EEPS2.6	Power Systems Automation Laboratory	--	3	30	70	100	2
EEPS2.7	Electrical Energy Systems Laboratory	--	3	50	50	100	2
EEPS2.8	Seminar	--	--	100	--	100	2
Total							**18**

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SEMESTER–III

Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS3.1	Professional Elective -V a) HVDC and EHVAC Transmission b) Smart Grid Technologies c) SCADA and WAMS	3	--	30	70	100	3
EEPS3.2	Open Elective: a. Business analytics b. Industrial safety c. Cost management of engineering projects d. Composite materials e. Waste to energy	3	--	30	70	100	3
EEPS3.3	Major Project (Phase-I Dissertation)	--	--	100	---	100	10
Total							**16**

SEMESTER–IV

Sub.Code	Subject Name	Period/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS4.1	Major Project (Phase-II Dissertation)	--	--	--	100	100	16
Total							**16**

EEPS1.1 ADVANCED POWER SYSTEM OPERATION AND DIGITAL PROTECTION

Unit Commitment: Constraints in unit commitment, Generation of state, optimizing the states using Priority-list method, Unit commitment problem solution using Priority-list method and Dynamic Programming; **Hydro-thermal Coordination:** Characteristics of various types of hydro-electric plants and their models, Introduction to hydro-thermal Coordination, Scheduling energy with hydro-thermal coordination, Short-term hydro-thermal scheduling.

Optimal Power Flow: Optimal power-flow problem formulation for loss and cost minimisation, Solution of optimal power flow problem using Newton's method and Linear Programming technique; **Voltage Control:** Automatic voltage regulator, Exciter types, Exciter modelling, Generator modelling, Static and Dynamic response of AVR loop.

State Estimation in Power System: Introduction, basic methods of State Estimation, State Estimation from non-linear measurements, Static State Estimation for Power Systems, State Estimation process in Power Systems, Bad data in measurement vector, Network Observability, Application of Power Systems State Estimation,

Numerical Relays: Introduction, Data Acquisition System, Numerical Relaying Algorithms, Mann-Morrison technique, DFT technique, Wavelet Transform technique, Removal of DC offset, Numerical overcurrent, distance and differential protection. **Microprocessor based Relays:** Introduction, IC elements and circuits for interfaces, A/D converters, Analog Multiplexers, S/H circuit, Overcurrent relays, Impedance relays, directional relays, reactance relay, Mathematical expression for distance relays, measurement of R and X, Mho and offset Mho relays, Generalised interface for distance relays.

Artificial Intelligence Based Numerical Protection: Introduction, Artificial Neural Network, Fuzzy Logic, Application of Artificial Intelligence to Power System Protection, Application of ANN to Overcurrent Protection, Application of ANN to Transmission Line Protection, Neural Network Based Directional Relay, ANN Modular Approach for Fault Detection, Classification and Location, Wavelet Fuzzy Combined Approach for Fault Classification, Application of ANN to Power Transformer Protection, Power Transformer Protection Based on Neural Network and Fuzzy Logic, Power Transformer Protection Based Upon Combined Wavelet Transform and Neural Network, Application of ANN to Generator Protection.

Text Books:

1. Power Generation, Operation and Control, Allen J. Wood and Bruce F. Wollenberg, John Wiley & Sons, Inc., New York, 2nd edition, 1996.
2. Electric Energy Systems Theory: An Introduction, Olle I. Elgerd, TMH Publishing Company Ltd., New Delhi, 2nd edition, 1983.
3. Power system protection & switchgear by Badri Ram & D N Vishwakarma, TMH, 2/e, 2011.

Reference Books:

1. Power System Engineering, D P Kothari and I J Nagrath, Second Edition, McGraw Hill

Education India Pvt.
2. Power system Analysis Operation and Control by Abhijit Chakrabarti and Sunita Halder, PHI
3. Electrical Power System Protection – C.Christopoulos and A.Wright-Springer.
4. Protection & Switchgear –Bhavesh Bhalaja, R.P Maheshwari, Nilesh G. Chothani-Oxford publisher.

EEPS 1.2 MODELLING OF POWER SYSTEM AND FACTS

Transmission Systems: Introduction, Linear Transmission techniques, Basic single-phase modelling, three-phase system analysis, three-phase models of transmission lines, evaluation of overhead line parameters, three phase models of transformers, formation of system admittance matrix.

Load flows: Newton-Raphson load flow method (polar and rectangular models), introduction to sparsity programming, triangular factorization, and optimal ordering, Fast decoupled load flow, convergence criteria and tests, Three phase load flow – Notation, synchronous machine modelling, specified variables, derivation of equations.

Introduction to FACTS: Transmission Interconnections, Power Flow in AC System, Factors Limiting the Loading Capability of Transmission Lines, Power Flow and Dynamic Stability Considerations, Importance of Controllable Parameters, Types of FACTS Controllers, Types of Converter, Concept and operation of Voltage sourced converters, Current Sourced converters, Operation of Single-Phase and Three-Phase Bridge Converters, Description of Three-Level VSC and PWM Converters, Transformer Connections for 12-pulse, 24-pulse and 48-pulse operation.

Shunt, Series Type FACTS Controllers (Operation and Theoretical Descriptions only): Objective of Shunt Compensation, Methods of Controllable Shunt VAR Generation (Variable Impedance type, Switching Converter type and Hybrid type), Objective of Series Compensation, Methods of Controllable Series VAR Generation (Variable Impedance type, Switching Converter type and Hybrid type).

UPFC and IPFC: Unified Power Flow Controller (UPFC) – Principle of operation, Transmission Control Capabilities, Independent Real and Reactive Power Flow Control;Principle of operation and Characteristics of Interline Power Flow Controller (IPFC), UPFC and IPFC control structures (only block diagram description).

Text Books:

1. Computer Modelling of Electrical Power Systems, J Arrillaga and N R Watson, John Wiley & Sons, New York, 2001.
2. Understanding FACTS: Concepts and Technology ofFlexible AC Transmission Systems, Narain G. Hingorani and Laszlo Gyugyi, IEEE Press, Wiley-Interscience, New Jersey, 2000.

Reference Books :

1. Thyristor-Based FACTS Controllers for Electrical Transmission Systems, R Mohan Mathur and Rajiv K Varma, IEEE Press, Wiley-Interscience, New Jersey, 2002.
2. FACTS Controllers in Power Transmission and Distribution, K R Padiyar, New Age International Publishers, New Delhi, 2007

EEPS 1.3a : OPTIMIZATION AND EVOLUTIONARY ALGORITHMS

Introduction to Optimization: Introduction, Historical Development, Engineering Applications of Optimization, Statement of Optimization Problem.

Classical Optimization Techniques: Introduction, Single variable optimization, Multivariable optimization with no constraints; Multivariable optimization with Equality constraints – Solution by Direct Substitution method, Method of constrained variation, Method of Lagrangian multipliers; Multivariable optimization with inequality constraints: Kuhn-Tucker conditions.

Linear and Non-Linear Programming:
Linear Programming: Introduction, Applications of Linear Programming, Standard Form of a Linear Programming, Basic Terminology and Definitions, Exceptional cases, Simplex method, Big-M method, Two-phase method, Revised Simplex method, Duality, Decomposition Principle.

Non-Linear Programming: Unconstrained optimization-Univariate method, Pattern Directions, Powell's method, Gradient of a function, Steepest descent method, Conjugate Gradient Method, Newton's method, Marquardt Method, Quasi-Newton Methods, Davidon-Fletcher-Powell Method, Broyden-Fletcher-Goldfarb-Shanno Method.

Modern Methods of Optimization
Introduction, Genetic Algorithms, Particle Swarm Optimization, Optimization of Fuzzy Systems Multi-objective Optimization and application to general two objective optimization problem.

Text Book:
Engineering Optimization: Theory and Applications By Singiresu S. Rao, Fourth Edition, 2009, John Wiley & Sons,

Reference Books:

1. Xin-she Yang, "Recent Advance in Swarm Intelligence and Evolutionary Computation", Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Ded, "Multi-Objective Optimization using Evolutionary Algorithms", John Wiley & Sons, 2001.
3. James Kennedy and Russel E Eberheart, "Swarm Intelligence", The Morgan Kaufmann Series in Evolutionary Computation, 2001.

EEPS 1.3b : ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Introduction to AI & ML: History of AI, Comparison of AI with Data Science, Need of AI in Engineering, Introduction to Machine Learning. Basics: Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation, **Approaches to AI:** Cybernetics and brain simulation, Symbolic, Sub-symbolic, Statistical, **Approaches to ML**: Supervised learning, Unsupervised learning, Reinforcement learning.

Feature extraction: Statistical features, Principal Component Analysis, **Feature selection:** Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Engineering.

Classification: Decision tree, Random forest, Naive Bayes, Support vector machine, **Regression:** Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Engineering.

ML Model development: classification, clustering, regression, ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training (Training, Testing, K-fold Cross Validation), Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions.

Reinforced Learning: Algorithms: Value Based, Policy Based, Model Based; Positive vs Negative Reinforced Learning; Models: Markov Decision Process, Q Learning. Characteristics of **Deep Learning**, Artificial Neural Network, Convolution Neural Network. Application of Reinforced and Deep Learning in Engineering.

Text books:

1. Mathematics for Machine Learning, Marc Peter Deisenroth, A Aldo Faisal and Cheng Soon Ong, Cambridge University Press, 2024.
2. Machine Learning and Artificial Intelligence, Ameet V Joshi, Springer, 2020.
3. Artificial Intelligence: Building Intelligent systems, Parag Kulkarni and Prachi Joshi, PHI, New Delhi, 2015.
4. Artificial Intelligence: A Modern Approach, Stuart Russel and Peter Norvig, 3rd edition, Pearson New International Edition, 2014.

Reference books:

1. Emerging Trends and Applications of Machine Learning, Solanki, Kumar, Nayyar, IGI, Global, 2018.
2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
4. Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)
5. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH

EEPS 1.3c: ELECTRICAL DISTRIBUTION SYSTEMS AND AUTOMATION

Distribution System Fundamentals : Brief description about electrical power transmission and distribution systems, Different types of distribution sub-transmission systems, Substation bus schemes, Factors effecting the substation location, Factors effecting the primary feeder rating, types of primary feeders, Factors affecting the primary feeder voltage level, Factors affecting the primary feeder loading.

Distribution System Substations And Loads : Substations: Rating of a distribution substation for square and hexagonal shaped distribution substation service area, Derivation of K constant, Radial feeder with uniformly and non-uniformly distributed loading. **Loads:** Various types of loads, Definitions of various terms related to system loading, detailed description of distribution transformer loading, feeder loading, Modelling of star and delta connected loads, two-phase and single-phase loads, shunt capacitors.

Distribution System Load Flow : Exact line segment model, Modified line model, approximate line segment model, Review of the two-winding transformer theory, two-winding auto transformer, Step-Voltage Regulators, Line drop compensator, Forward/Backward sweep distribution load flow algorithm.

Underground Distribution : Applications-underground residential distribution, main feeders, urban systems, comparison with overhead, Cables – cable insulation, conductors, neutral or shield, semiconducting shields, jacket, Installation and configurations, Impedances – resistance, impedance formulas, impedance tables, capacitance, Ampacity, Fault withstand capability, Cable reliability, cable testing, fault location.

Distribution automation functions: Electrical system automation, EMS functional scope, DMS functional of DMS – Steady state and dynamic performance improvement; Geographic information systems – AM/FM functions and Database management; communication options, supervisory control and data acquisition: SCADA functions and system architecture; Synchrophasors and its application in power systems.

Books:

1. William H. Kersting, “Distribution System Modelling and Analysis”, CRC Press, Newyork, 2002.
2. Turan Gonen, “Electric Power Distribution System Engineering”, McGraw-Hill Inc., New Delhi, 1986.
3. Electric Power Distribution Handbook, T A Short, 2nd edition, CRC Press, London.
4. Juan M Gers, “Distribution System Analysis and Automation”, The Institution of Engineering and Technology, London, UK, 2013.

EEPS 1.4a : POWER QUALITY

Introduction : Significance of power quality, Various power quality parameters, Voltage vs Current distortion, Harmonic indices – THD, TDD; Harmonic analysis, Harmonic phase sequence, Triplen harmonics, Inter harmonics.

Harmonics effects : Sources of harmonics, Resonance, effects of harmonics on rotating machine, measuring instruments, ripple control systems, power system protection, consumer equipment, communication systems.

Harmonic elimination : Passive filters – design, advantages and disadvantages; Shunt active filters – Principle of operation, configurations, design and control strategies; Three phase four- wire shunt active power filters.

Voltage Quality : Sources of Sags, Swell, Unbalance and Harmonics; Voltage quality standards, effects of Sags, Swell, Voltage Sag Magnitude ,Voltage Sag Duration, Three-Phase Unbalance, Phase-Angle Jumps, Magnitude and Phase-Angle Jumps for Three-Phase Unbalanced Sags, Load Influence on Voltage Sags, Sags due to Starting of Induction Motors.

Voltage Quality Improvement : Principle of operation, configuration, design and control strategies of series active power filters, three phase four wire series active power filters, UPQC principle, topologies.

Books

1. Dugan Roger C, Santoso Surya, McGranaghan, Marks F Beaty and H Wayre, " Electrical Power System Quality", McGraw Hill, 3rd edition, 2012.
2. J Arrilaga and N R Watson, "Power System Harmonics", John Wiley & Sons Ltd., 2nd edition, 2003.
3. Hirofumi Akagi, Edson Hirokazu Watanabe and Mauricio Aredes, " Instantaneous Power Theory and Applications to Power Conditioning", Wiley-IEEE Press, 2007.
4. Math H Bollen, "Understanding Power Quality Problems", IEEE Press.

EEPS 1.4b: POWER SYSTEM RELIABILITY

Basic probability theory – rules for combining probabilities of events – Bernoulli's trails – probability density and distribution functions – binomial – distributions – expected value and standard deviation of binomial distribution.

Network Modelling and Reliability Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method.
Reliability functions F(t), R(t), h(t) and their relationship – exponential distributions – 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

Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state probabilities – Markov processes one component repairable system – time dependent probability evaluation using Laplace transform approach – evaluation of limiting state probabilities using STPM – two component repairable models – Frequency and duration concept-Evaluation of frequency of encountering state, mean cycle time, for one, two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering merged states.

Generating capacity—basic probability methods – The generation system model – Loss of load indices – Equivalent forced outage rate- Capacity expansion analysis – Scheduled outages – Evaluation methods on period bases-Load forecast uncertainty- Forced outage rate uncertainty- Loss of energy indices Practical system studies Problems

Composite generation and transmission systems, Radial configuration- Network configurations – State selection- System and load point indices- Application to practical systems- Data requirements for composite system reliability- Evaluation techniques- Additional interruption indices- Application to radial systems- Effect of lateral distributor protection- Effect of disconnects- Effect of protection failures- Effect of transferring loads- Probability distributions of reliability indices- Inclusion of weather effects

Reference Books:

1. Reliability Evaluation of Engg. System – R. Billinton, R.N. Allan, Plenum Press, New York.
2. Reliability Evaluation of Power Systems -Second edition Roy Billinton, Ronald N. Allan. Plenum Press, New York.
3. An Introduction to Reliability and Maintainability Engineering. Sharies E Ebeling, TATA McGraw Hill – Edition.

EEPS 1.4c: IoT IN POWER SYSTEMS

Introduction to IoT: Introduction, History, Applications of IoT, Technical Details of IoT, Recent Developments, Challenges.

IoT and its Requirements for Renewable Energy Resources: Introduction, Industrial IoT, RES and IoT, Challenges of IoT in EMS Post-implementation, Solution to IoT Challenges.

Power Quality Monitoring of Low Voltage Distribution System Toward Smart Distribution Grid Through IoT: Introduction, Introduction to Various PQ Characteristics, Introduction to IoT, Smart Monitoring using IoT for the Low Voltage Distribution System, Power Quality Monitoring of Low Voltage Distribution System – Case Study.

Health Monitoring of a Transformer in a Smart Distribution System using IoT: Introduction, Introduction to the Transformer, Failure of the Distribution Transformer, Transformer Health Monitoring System through IoT, Case Study.

Introduction To Machine Learning Techniques: Why and What is Machine Learning, Some Crucial Algorithmic Mathematical Models in Machine Learning, Pre-Eminent Python Libraries Intended for Machine Learning, Machine Learning Techniques in State of Affairs of Power Systems.

Machine Learning Techniques for Renewable Energy Resources: Introduction, Overview of Machine Learning, Deep Learning Architecture, LSTM network based prediction-Case Study

Application of optimization technique in modern hybrid power systems
Introduction, modern power system, Optimization techniques and proposed technique-case study

Machine Learning Techniques in modern hybrid power systems-A Case Study:
Introduction, Technical issues in modern hybrid power systems, application of ML and Optimization techniques in modern hybrid power systems, a prediction case study of ML in MHPS, Optimization block in MHPS

TEXT BOOK:

IoT, Machine Learning And Block Chain Technologies For Renewable Energy And Modern Hybrid Power Systems, By C. Sharmeela, P.Sanjeev Kumar, P.Sivaraman, Meera Joseph, River Publishers 2022.

EEPS 1.5: RESEARCH METHODOLOY AND IPR

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem - Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Effective literature studies approaches, analysis Plagiarism, Research ethics.

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property - Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights - Licensing and transfer of technology - Patent information and databases - Geographical Indications.

New Developments in IPR: Administration of Patent System - New developments in IPR; IPR of Biological Systems, Computer Software etc. - Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Audit Course - I

EEPS 1.6a : ENGLISH FOR RESEARCH PAPER WRITING

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

REFERENCE BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

EEPS 1.6b : DISASTER MANAGEMENT

Introduction to Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types and Magnitude.

Repercussions Of Disasters And Hazards: Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas in India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival

Disaster Mitigation Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

EEPS 1.6c : SANSKRIT FOR TECHNICAL KNOWLEDGE

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Order - Introduction of roots - Technical information about Sanskrit Literature

Technical concepts of Engineering-Electrical, Mechanical, Architecture,

Mathematics

REFERENCES:

1. Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. India's Glorious Scientific Tradition" Suresh Soni, Ocean book s (P) Ltd., New Delhi.

EEPS 1.6d : VALUE EDUCATION

Values and self-development - Social values and individual attitudes - Work ethics, Indian vision of humanism - Moral and non - moral valuation - Standards and principles - Value judgements

Importance of cultivation of values - Sense of duty - Devotion, Self-reliance - Confidence, Concentration. Truthfulness, Cleanliness - Honesty, Humanity - Power of faith, National Unity – Patriotism - Love for nature, Discipline

Personality and Behaviour Development - Soul and Scientific attitude - Positive Thinking - Integrity and discipline - Punctuality, Love and Kindness - Avoid fault Thinking - Free from anger, Dignity of labour - Universal brotherhood and religious tolerance - True friendship - Happiness Vs suffering, love for truth - Aware of self-destructive habits - Association and Cooperation - Doing best for saving nature

Character and Competence –Holy books vs Blind faith - Self-management and Good health - Science of reincarnation - Equality, Nonviolence, Humility, Role of Women - All religions and same message - Mind your Mind, Self-control - Honesty, Studying effectively

REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

EEPS 2.1 : AUTOMATION IN POWER SYSTEMS

Introduction To Power System Automation: Historical development of power system automation, Fundamentals of electrical protection and automatic power control system, development of protective relays, controller relays and relaying devices, elements of automation systems.

Central Control and Management: Introduction, Power System Operation, Operations Environment of Distribution Networks, Evolution of Distribution Management Systems, Basic Distribution Management System Functions, Basis of a Real-Time Control System (SCADA), Outage Management, Decision Support Applications, Subsystems, Performance Measures and Response Times, Database Structures and Interfaces.

Design, Construction, and Operation of Distribution Systems, MV Networks: Introduction, Design of Networks, LV Distribution Networks, Switchgear for Distribution Substations and LV Networks, Extended Control of Distribution Substations and LV Networks.

Communication Systems for Control and Automation: Introduction, Communications and Distribution Automation, Distribution Automation Communications Protocols, Distribution Automation Communications Architecture, DA Communications User Interface, Some Considerations for DA Communications Selection, Requirements for Dimensioning the Communication Channel

Substation Automation: Substation Automation, Functions of Substation Automation System, State and Trends of Substation Automation, Intelligent, Affordable Substation Monitoring and Control, Standard for substation automation – Logical Nodes (LN), Logical Device (LD), Intelligent Electronic Devices (IEDs), Process level functions, Bay level functions, Station Level Functions, Station Bus and Process Bus

Text Books

1. P I Zabolotny, "Automation in Electrical Power Systems", MIR Publishers, Moscow.
2. James Northcote-Green and Robert Wilson, "Control and Automation of Electrical Power Distribution Systems", CRC Taylor & Francis, New York, 2007.
3. M K Khedkar and G M Dhole, "A Textbook of Electric Power Distribution Automation", University Science Press, New Delhi, 2010.
4.

Reference Books:

1. Helfrick – Cooper, Modern electric instrumentation and measurement technique, PHI 1994.
2. T.S. Rathore, Digital measurement techniques, Narosa publishing House, 1996.
3. John Webb, Ronald Reis - Programmable Logic Controllers , PHI, 2003.
4. Klaus-Peter and Others – Substation Automation Handbook, Utility Automation Consulting Lohmann, ISBN 3-85758-951-5
5. P I Zabolotny, "Automation in Electrical Power Systems", MIR Publishers, Moscow.

EEPS 2.2 POWER SYSTEM DYNAMICS AND STABILITY

Modeling: Basic concepts, Review of classical methods, modeling of synchronous machine, Park's transformation, Analysis of steady state performance, Excitation system, excitation system modeling, Excitation systems-standard block diagram, System representation by state equations, Prime mover control system, Transmission lines, SVC and Loads modeling, D-Q transformation using α-β variables.

Dynamics of a Synchronous generator connected to infinite bus: System model, synchronous machine model, Application model(1.1), Calculation of initial conditions, System simulation, Consideration of other machine models, Inclusion of SVC model,

Small Signal Stability Analysis: Analysis of single machine system, small signal analysis with block diagram representation, Characteristic equation and application of Routh-Hurwitz criterion, synchronizing and damping torque analysis, small signal model, state equations.

Application of Power System Stabilizers: Introduction, Basic concepts in applying PSS, Control signals, structure and tuning of PSS.

Analysis of Multi- Machine system: A simplified system model, detailed models, Case I and II, Inclusion of load and SVC dynamics, modal analysis of large power systems.

Text Books:

1. Power System Dynamics: stability and control, K. R. Padiyar, 2nd edition, BS Publications, Hyderabad, 2008.
2. Power system control and stability, PM Anderson and A A Fouad, 2nd edition, Wiley-Interscience, 2003.

Reference Books:

1. Power System Stability and Control, Prabha Kundur, Mc. Graw-Hill Inc., New Delhi, 1994.
2. Power System Stability, Vol I, II and III, E W Kimbark, IEEE Press, Wiley-Interscience, 1995

EEPS 2.3a HYBRID ELECTRIC VEHICLES

Introduction

Fundamentals of vehicle – components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; history of hybrid vehicles-advantages and applications of Electric and Hybrid Electric Vehicles.

Hybridization of Automobile

Architecture of HEVs-series and parallel HEVs – complex HEVs, Plug-in hybrid vehicles (PHEV-constituents of PHEV- comparison of HEV and PHEV; Extended range hybrid electric vehicles(EREVs)-blended PHEVs-Fuel Cell vehicle and its constituents.

Special machine for EV and HEVs

Characteristics of traction drive-requirement of electric motors for EV/HEVs, Induction Motor drives –their control and applications in EV/HEVs. Brushless DC Motors: Advantages- control of application in EV/HEVs. Switch Reluctance motors: Merits limitations – converter configuration-control of SRM for EV/HEVs.

Power Electronics in HEVs

Boost and Buck-Boost converters-Multi Quadratn DC-DC onverters – DC-AC Inverter for EV and HEV applications – Three Phase DC-AC inverters – Voltage control of DC-AC inverters using PWM – EV and PHEV battery chargers.

Energy Sources for HEVs

Energy Storage-Battery based energy storage and simplified models of battery-fuel cells-their characteristics and simplified models-super capacitor based energy storage-its analysis and simplified models-flywheels and their modeling for energy storage in EV/HEV- Hybridization of various energy storage devices.

Text Books

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, 2014
2. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003.

Reference Books

1. Modern Electric – Hybrid Electric and Fuel Cell Vehicles: Fundamentals – Theory and Design, Sebastian E. Gay – Ali Emadi, CRC Press, 2004.
2. Electric Vehicle Technology Explained, James Larminie and John Lowry, Wiley, 2003.
3. Modern Electric Traction, H. Partab, Dhanpat Rai & Co, 2007.

EEPS 2.3b ENERGY STORAGE TECHNOLOGY

Energy storage systems overview - Scope of energy storage, needs and opportunities in energy storage, Technology overview and key disciplines, Thermal storage system -heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage - organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors, Importance of energy storage systems in electric vehicles, Current electric vehicle market.

Chemical storage system- hydrogen, methane etc., concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.

Electromagnetic storage systems - double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.

Electrochemical storage system: (a) Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery. (b) Supercapacitors- Working principle of supercapacitor, types of supercapacitors, cycling and performance characteristics, difference between battery and supercapacitors, Introduction to Hybrid electrochemical supercapacitors, (c) Fuel cell: Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems.

Battery design for transportation, Mechanical Design and Packaging of Battery Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Lithium-Ion Batteries, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles.

Text books:

1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press, 2011.
2. Energy storage: A new approach, Ralph Zito, Wiley, 2010.

Reference:

1. Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost, Pistoia, Gianfranco, and Boryann Liaw, Springer International Publishing AG, 2018.
2. Robert A. Huggins, Energy storage, Springer Science & Business Media (2010)

EEPS 2.3c ENERGY AUDITING AND MANAGEMENT

Global and Indian Energy Scenarios
Energy Conservation, Energy Audit, Energy Scenario of India, Present Nonrenewable Energy Scenario, Present Energy Consumption, Energy Security, Energy Strategy for the Future

Types of Energy Audits and Energy-Audit Methodology
Definition of Energy Audits, Company/Building Where Energy Audit is Performed, Energy-Audit Methodology, Financial Analysis, Sensitivity Analysis, Project-Financing Options., Energy Monitoring and Targeting

Survey Instrumentation
Electrical Measurement, Thermal Measurement, Light Measurement, Speed Measurement, Data Logger and Data-Acquisition System,

Energy efficient air conditioning and mechanical ventilation
Impact of air conditioning, Air-Conditioning Systems, Refrigeration system, Problems of traditional design approach, Alternative approaches, Energy efficient refrigeration, Splitting sensible cooling and ventilation, Fabric thermal storage, Ice thermal storage, Evaporating cooling, Desiccant cooling systems

Energy efficient electrical services
Introduction, Power factor, Electric motors, Variable speed drives, Lighting energy consumption, Artificial lighting design, Energy efficient lighting

Energy Audit Applied to Buildings
Energy-Saving Measures in New Buildings, Water Audit, How to Audit Your Home?,
General Energy-saving Tips Applicable to New as Well as Existing Buildings

Text Books:
1. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill
2.Energy: Management, Supply and Conservation by Beggs, C. Elsevier Science & Technology Books

Reference Books:
1. Energy management by W.R. Murphy & G. McKay Butter worth, Elsevier publications. 2012
2. Energy management hand book by W.C. Turner, John Wiley and sons.
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc. Ltd–2 nd edition, 1995

EEPS 2.4a : POWER SYSTEM DEREGULATION

Why Deregulate, Conditions For Deregulation, Problems With Regulation, The Benefits Of Competitive Wholesale Markets, The Benefits Of Real-Time Rates, What To Deregulate, Ancillary Services And The System Operator, Unit Commitment And Congestion Management, Risk Management And Forward Market, Transmission And Distribution, Retail Competition, Measuring Power And Energy, Measuring Generation Capacity, Pricing Generation Capacity, Technical Supplement.

What Is Competition, The Efficiency of Perfect Competition, Short- And Long-Run Equilibrium Dynamics, Competition Good for Consumers, Marginal Cost in A Power Market, The Role of Marginal Cost, Marginal-Cost Fallacies, The Definition of Marginal Cost, Marginal Cost Results, Working with Marginal Costs, Scarcity Rent, Market Structure, Reliability Requirements, Effective Demand Elasticity, Long-Term Contracts, Supply Concentration

Congestion Pricing Fundamentals, Congestion Pricing Is Competitive Pricing, Benefits of Competitive Locational Prices, Congestion Pricing Methods, Centralized Computation of CLPs, Bilateral Pricing Compared to Centralized Pricing, Congestion Pricing Fallacies, Refunds and Taxes, Pricing Losses on Lines.

Transmission Rights, he Purpose of Transmission Rights, Using Financial Transmission Rights, Revenues from System-Issued Financial Rights, Physical Transmission Rights.
Interchange, Pooling, Brokers, and Auctions, Interchange Contracts, Energy Interchange between Utilities, Interutility Economy Energy Evaluation, Interchange Evaluation with Unit Commitment, Multiple Utility Interchange Transactions—Wheeling, Power Pools, The Energy-Broker System, Transmission Capability General Issues, Available Transfer Capability and Flow gates. Security Constrained Unit Commitment, Auction Emulation using Network LP, Sealed Bid Discrete Auctions.

ANCILLARY SERVICES MANAGEMENT, Ancillary Services Management in Various Countries, Ancillary Services Management in Various Countries, Concluding Remarks, RELIABILITY AND DEREGULATION, Reliability Analysis, The Network Model, Reliability Costs, Hierarchical Levels, Reliability and Deregulation

Text Books:

1. Power System Economics: Designing markets for electricity – S. Stoft, wiley.
2. Power Generation,Operation, And Control, Allen J. Wood Bruce F. Wollenberg Gerald B. Sheblé 3rd edition ,IEEE.
3. Operation of restructured power systems – K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Springer.

EEPS 2.4b : RENEWABLE ENERGY SYSTEMS

Introduction: Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics – Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power systems.

Biomass energy:
Introduction, Biomass Resources, Energy From Biomass, Conversion Processes, Biomass Cogeneration, Environmental Benefits, Geothermal Energy: Basics, Direct Use, Geothermal Electricity, Mini/Micro Hydro Power: Classification Of Hydropower Schemes, Classification of Water Turbine, Turbine Theory, Essential Components Of Hydroelectric System.

Wind Power Plants: Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation – General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines – Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

Photovoltaic Power Plants: Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics – Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O, INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

Fuel Cells: The Fuel Cell; Low– and High–Temperature Fuel Cells; Commercial and Manufacturing Issues – Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers; Electrolyser Systems; Advantages and Disadvantages of Fuel Cells – Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage.

Text Books:

1. Felix A. Farret, M. Godoy Simo'es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.
3. D.P.Kothari,k.c.Singal,Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", Phi Learning Pvt.Ltd, New Delhi, 2013

Reference Books

1. A.K. Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap." Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig. Adebayo A. Ogundipe and Maria Papadakis." Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy". Open University, Oxford University Press in association with the Open University, 2004.

EEPS 2.4c : REAL TIME CONTROL OF POWER SYSTEMS

Power System Security: Introduction, Factors affecting the power system security, Contingency analysis procedure, Linear sensitivity factors: Line outage distribution factors and Generation shift factors, and its derivation; AC power flow method, contingency selection.

Voltage Control : Production and absorption of reactive power, Methods of voltage control, Shunt reactors, Shunt capacitors, Series capacitors, Synchronous condensers, Static Var systems, Principles of transmission system compensation, Modelling of reactive compensating devices, Application of tap-changing transformers to transmission systems, Distribution system voltage regulation, Modelling of transformer ULTC control systems.

Voltage Stability : Basic concepts related to voltage stability – Transmission system characteristics, Generator characteristics, Load characteristics, reactive compensating devices characteristics; Voltage collapse – Typical scenario, General characterisation, Classification of voltage stability; Voltage stability analysis – Modelling requirements, Dynamic analysis, Static analysis, Determination of shortest distance to instability, continuation power flow analysis, Prevention of voltage collapse.

Synchrophasor Measurement units: Introduction, Phasor representation of sinusoids, a generic PMU, GPS, Phasor measurement systems, Communication options for PMUs, Functional requirements of PMUs and PDCs, Phasors for nominal frequency signals, types of frequency excursions in power systems, DFT estimation at off nominal frequency with a nominal frequency clock.

Protection System Reliability and Testing: Reliability Concepts, System Reliability Analysis Methods, Improving Availability, Selecting Reliable Protective Relays, Relay testing and commissioning, Testing Microprocessor based Relays, Panel and Substation Control Enclosure Design

Text Books:

1. Allen J. Wood, Bruce F. Wollenberg and Gerald B Sheble “Power Generation, Operation and Control”, John Wiley & Sons, Inc., New Jersey, 3nd edition, 2014.
2. Prabha Kundur, “Power System Stability and Control”, McGraw-Hill, Inc., New Delhi, 1994.
3. A G Phadke and J S Thorp, “Synchronized Phasor Measurements and Their Applications”, Springer, 2008.
4. Modern Solutions for Protection ,Control and Monitoring of Electrical Power Systems,Hector J.Altuve Ferrer,Edmund O.Schweitzer III

Audit Course - II

EEPS 2.5a : CONSTITUTION OF INDIA

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble - Salient Features

Contours of Constitutional Rights & Duties - Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.

Organs of Governance: Parliament - Composition - Qualifications and Disqualifications - Powers and Functions – Executive - President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat - Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Election Commission: Role and Functioning - Chief Election Commissioner and Election Commissioners - State Election Commission: Role and Functioning - Institute and Bodies for the welfare of SC/ST/OBC and women.

REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. 2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

EEPS 2.5b : PEDAGOGY STUDIES

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

Research gaps and future directions: Research design, Contexts Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. ondon: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

EEPS 2.5c : STRESS MANAGEMENT BY YOGA

Yoga: Royal Road to Higher Consciousness: Consciousness or Chaitanya in Mandukya Upanishad, Bhagavad Gita, Yoga Sutras, Astavakra Gita; methods of accessing higher states of consciousness – overcoming body consciousness, overcoming mind consciousness; higher consciousness and person transformation; higher consciousness and parapsychic powers (siddhis).

Vedanta: A Philosophy of Pure Consciousness – Consciousness according to Advaita, Dvaita and Visistadvaita schools, Consciousness according to Nyaya, Vaisesika and Sankya Schools. Self - awareness – Ramana Maharshi; Buddhism: A Psychology of Consciousness: - viññā a,5 aggregates, 12 nidhanasm, cetasikas, nirvana.
The Mind-Body Relationship, the concept of Psychological Health in India, Scope of Health Psychology Emergence of Behavioural Medicine.

Stress – Stressors: Environmental, Social and Psychological, stress and illness, control and stress.

REFERENCES:

1. S. Menon, B.V.Sreekantan, Anindya Sinha, Philip Clayton, R Narasimha (2004). Science and Beyond: Cosmology, consciousness and technology in Indic traditions. National Institute of Advanced Studies, Bangalore
2. Nakamura (1989). Indian Buddhism, Motilāl Banārsidass, Delhi.
3. Goleman, D & Gurin, J. (1993). Mind – Body Medicine, New York.

EEPS 2.5d : PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Neetisatakam - Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Approach to day to day work and duties.

- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23,35,
- Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad BhagwadGeeta:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

REFERENCES:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath
3. Rashtriya Sanskrit Sansthanam, New Delhi.

EEPS 3.1a : HVDC and EHV AC TRANSMISSION

General aspects of DC transmission and comparison of it with AC transmission: Introduction, General aspects of transmission, Transmission links, types- Monopolar, Homopolar, Bipolar and Back-to-Back, Constitution of dc and ac links. Technical aspects, Economic aspects, Reliability aspects and Environmental aspects of HVDC Transmission (HVDCT), Advantages and disadvantages of HVDCT, Applications of DC Transmission, HVDC light.

Converters: Definition, Thury system, Valves, Valve characteristics, Components of circuits, Properties of converter circuits, Pulse number, Single phase and three phase converters, Assumptions in converter circuit analysis, Analysis of Greatz circuit, Analysis of bridge with grid control without overlap, Analysis of bridge with grid control with overlap less than 60^0

HVDC Links and Converters: Characteristics of converter circuits – Rectifier and inverter characteristics, complete characteristics of rectifier and inverter, Equivalent circuit of HVDC Link, Brief description of 12-pulse, 24-pulse and 48-pulse converters transformer configurations, Choice of converter circuit for HVDC transmission,

EHV line parameters - Resistance of conductors, temperature rise and current carrying capacity, properties of bundled conductors, inductance of EHV line configurations, line capacitance, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return, **Voltage Gradients** – electrostatics, field of sphere gap, field of line charges and their properties, Multi-conductor lines, surface voltage gradient on conductor, gradient factors and their use, distribution of voltage gradients on sub-conductors of bundle.

Theory of waves - Travelling waves and standing waves at power frequency, differential equations and solutions, standing waves and natural frequencies, open ended line and responses, line energization with trapped-charge voltage, corona loss and effective shunt conductance, reflection and refraction of travelling waves, transient response of systems, **Lightning –** lightning strokes to lines, lightning stroke mechanism, lightning protection problem, tower-footing resistance, insulator flashover and withstand voltages, probability of occurrence of ightning stroke currents, lightining arresters and protective characteristics, dynamic voltage rise and arrester rating, operating characteristics of lightning arresters.

Text Book:

1. E.W. Kimbark, Direct current transmission, Vol. I, Wiley Inter science, New York, 1971.
2. P Kundur, Power System Stability and Control, McGraw Hill Inc., New York, 1994.
3. Extra High Voltage AC Transmission Engineering, Rakosh Das Begamudre, 4^{th} edition, New Academic Science, 2013.

Reference Books:

1. K. R. Padiyar, HVDC Power Transmission Systems: Theory and System Interactions, New Age International Publishers, New Delhi, 2009.
2. Erich Uhlmann, Power Transmission by Direct Current, Springer-Verlag, Berlin/Heidelberg, 1975.

EEPS 3.1b : SMART GRID TECHNOLOGIES

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & Smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies on Smart Grid, case study of Smart Grid.

Smart Grid Technologies: Part1: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

Smart Grid Technologies: Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage, like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Microgrids and Distributed Energy Resources: Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

Power Quality Management in Smart Grid: Power Quality &EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Smart Grid, Web based Power Quality monitoring, Power Quality Audit.
Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN).

Books:

1. Ali Keyhani, Mohammed N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
2. clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
3. Janka Ekanayake, Nick Jenkins, KithsiriLiyanage, Lianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley
4. Jean Claude Sabonnadiere, NouredinHadjsaid, “Smart Grids”, Wiley Blackwell 19
5. Peter S. Fox Penner, “Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities”, Island Press; I edition 8 Jun 2010
6. S. Chowdhury, S.P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks. “ Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press
8. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability: I”, Artech House Publishers July 2011.

EEPS 3.1c : SCADA AND WAMS

SCADA systems, hardware and firmware: comparison of SCADA, DCS, PLC and smart instruments, Remote Terminal Units (RTU), PLCs as RTUs, master stations, system reliability and availability, communication architectures and philosophies.

SCADA systems, software and protocols: Introduction, components of SCADA system, SCADA software package, specialized SCADA protocols, error detection, distributed network protocols, new technologies in SCADA systems.

Local Area Network systems: Network topologies, media access methods, IEEE 802.3 Ethernet, High-speed Ethernet systems, fast Ethernet design considerations, Network interconnection components, TCP/IP protocols, SCADA and internet.

Synchrophasor Standards: Overview, Definitions, Acronyms, Abbreviations, Synchrophasor measurement – phasor definition, synchrophasor definition and measurement time synchronization, Synchrophasor measurement requirements and compliance verification – synchrophasor estimation, frequency and rate of change of frequency estimation, measurement evaluation, measurement reporting, measurement compliance.

Phasor measurement and applications: Synchrophasor measurement system – synchrophasor network, network elements, Multiple data streams from PMUs and PDCs, synchrophasor message format, Applications: Static state estimation, bad data detection, state estimation with phasor measurements, protection of transmission lines, adaptive protection.

TEXT BOOKS:

1. SCADA: Supervisory Control and Data Acquisition, Stuart A Boyer, ISA-The Instrumentation, systems, and Automation Society, USA, 2004.
2. IEEE Standard for Synchrophasor Measurements for Power Systems, IEEE Std C37.118.1 and C37.118.2 2011.
3. Synchronized Phasor Measurements and their Applications, Arun G Phadke and James S. Thorp, 2nd edition, Springer, 2017.

REFERENCES:

6. William T. Shaw, Cyber security for SCADA systems, Penn Well Books, 2006.
7. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes,2003.
8. Gordon Clarke, Deon Reynders, Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK, 2004

OPEN ELECTIVES

EEPS 3.2a : BUSINESS ANALYTICS

UNIT: I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT: II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT: III

Organization Structure: Organization Structure of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT: IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT: V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

UNIT: VI

Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

REFERENCES:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

EEPS 3.2b : INDUSTRIAL SAFETY

UNIT: I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT: II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT: IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT: V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

EEPS 3.2c : COST MANAGEMENT OF ENGINEERING PROJECTS

UNIT: I

Cost: Cost Elements, Pricing, Materials, Labour; Engineering, Equipment, Parts, and Tool; Economic Costs, Activity - Based Cost Management.

UNIT: II

Cost Estimating & Planning: Estimating, Process Product Manufacturing, Discrete Product Manufacturing. Planning and Scheduling.

UNIT: III

Progress & Cost Control: Progress Measurement and Earned Values, Earned Value for Variable Budgets, Tracking Cost and Schedule Performance, Performance and Productivity Management.

UNIT: IV

Project Management: Project Management Fundamentals, Project Organization Structure, Project Planning, Project Labour Cost Control, Leadership and Management of Project People, Quality Management, Value Analysis, Contracting for Capital Projects, Strategic Asset Management.

UNIT: V

Economic Analysis, Statistics & Probability: Basic Engineering Economics, Applied Engineering Economics, Statistics & Probability, Basic Concepts in Descriptive Statistics, Risk Management.

REFERENCES:

1. Charles J. Austin Industrial Engineering & Technology Building, (AG/IT 216)

EEPS 3.2d : COMPOSITE MATERIALS

UNIT: I

Introduction: Definition of composite 2 material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites.

UNIT: II

Performance of structural composites: Basic analytical concepts (Qualitative black box approach and Quantitative analytical approach), Performance analysis by various models (Law of Mixtures, Shear lag model, Laminated plate model, Eshelby's models and Other models, - thermo elasticity, plasticity and creep), Strengthening mechanisms, Stress distribution in fibre and the matrix (shear stress and axial tensile stress in the fibre along its length), critical length of fibre for full strengthening, Analysis of uniaxial tensile stress-strain curve of unidirectional continuous and short fibre composites, Estimation of the required minimum amount of fibre and critical amount of fibre to gain a composite strength, Analysis of strength of a composite during loading at an angle to the fibres, Nano-structured composites.

UNIT: III

Performance of Composite in Non- structural Applications: Composites in Electrical, Superconducting and Magnetic Applications, Nano-composite devices.

UNIT: IV

Industrial Application of Composite Materials: Civil constructions of structures/pannels, Aerospace industries, Automobile and other surface transport industries, Packaging industries, House hold and sports components etc.

UNIT: V

Fracture & amp; Safety of Composite: Fracture behaviour of composites, Mechanics and Weakest link statistics, Griffith theory of brittle fracture and modification for structural materials, Basic fracture mechanics of composite (Fracture toughness, COD and J-integral approaches, Fatigue crack growth rate), Fracture Mechanics of brittle matrix fibre composite, Fracture mechanics of metal matrix fibre composite, Experimental evaluation (composite), Elementary reliability analysis.

REFERENCES:

1. Composite materials, K.K. Chawala, 2nd ed., (1987) Springer-Verlag, New York.
2. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH Verlag GmbH Co. KGaA, Weinheim.
3. 3. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov, (2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5lGB, UK.
4. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993), Chapman & Hall, London.
5. Advances in composite materials, G. Piatti, (1978) Applied Science Publishers Ltd., London.

EEPS 3.2e : WASTE TO ENERGY

UNIT: I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT: II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT: III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT: IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT: V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:

1. Non - Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.