



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by Andhra Pradesh Act No.30 of 2008)

Kukatpally, Hyderabad – 500 085, Andhra Pradesh (India)

### B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)

#### IV YEAR II SEMESTER

Code	Subject	L	P	Credits
	Fundamentals of HVDC and FACTS Devices	4	-	4
	<b>Elective-III</b> Neural Networks and Fuzzy Logic Renewable Energy Sources Principles of Reliability Engineering	4	-	4
	<b>Elective-IV</b> Advanced Control Systems EHV AC Transmission Introduction to Nanotechnology	4	-	4
	Industry Oriented Mini Project	0	0	2
	Seminar	0	6	2
	Project Work	0	15	10
	Comprehensive Viva-Voce	0	0	2
	<b>Total</b>	<b>12</b>	<b>21</b>	<b>28</b>

**Note:**All End Examinations (Theory and Practical) are of three hours duration.

**T-Tutorial      L – Theory      P – Practical/Drawing      C – Credits**

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. EEE-II Sem

L T/P/D C

4 -/- 4

## (A80237) FUNDAMENTALS OF HVDC AND FACTS DEVICES

### Objective:

This subject deals with the importance of HVDC transmission, analysis of HVDC converters, Harmonics and Filters, Reactive power control and Power factor improvements of the system. It also deals with basic FACTS concepts, static shunt and series compensation and combined compensation techniques.

### UNIT – I:

**Introduction:** Comparison of AC and DC transmission systems, application of DC transmission, types of DC links, typical layout of a HVDC converter station. HVDC converters, pulse number, analysis of Gratez circuit with and without overlap, converter bridge characteristics, equivalent circuits or rectifier and inverter configurations of twelve pulse converters.

### UNIT – II:

**Converter & HVDC System Control:** Principles of DC Link Control – Converters Control Characteristics – system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link.

### UNIT-III:

**Harmonics, Filters and Reactive Power Control :** Introduction, generation of harmonics, AC and DC filters. Reactive Power Requirements in steady state, sources of reactive power, static VAR systems.

**Power Flow Analysis in AC/DC Systems:** Modeling of DC/AC converters, Controller Equations-Solutions of AC/DC load flow –Simultaneous method-Sequential method.

### UNIT-IV:

**Introduction to FACTS :** Flow of power in AC parallel paths and meshed systems, basic types of FACTS controllers, brief description and definitions of FACTS controllers.

**Static Shunt Compensators:** Objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators, SVC and STATCOM, comparison between SVC and STATCOM.

### UNIT – V:

**Static Series Compensators :** Objectives of series compensation, variable impedance type-thyristor switched series capacitors (TCSC), and switching

converter type series compensators, static series synchronous compensator (SSSC)-power angle characteristics-basic operating control schemes.

**Combined Compensators:** Introduction, unified power flow controller (UPFC), basic operating principle, independent real and reactive power flow controller, control structure.

#### TEXT BOOKS:

1. HVDC Transmission, S. Kamakshiah, V. Kamaraju, The Mc – Graw Hill Companies.
2. Understanding FACTS, Concepts and Technology of Flexible AC Transmission Systems, Narain. G. Hingorani, Laszlo Gyugyi, IEEE Press, Wiley India.

#### REFERENCE BOOKS:

1. HVDC and Facts Controllers Applications of Static Converters in Power Systems, Vijay K. Sood, Kluwer Academic Publishers.
2. HVDC Power Transmission Systems: Technology and system Interactions, K.R.Padiyar, New Age International (P) Limited.
3. Thyristor – Based Conrollers for Electrical Transmission Systems, R. Mohan Mathur, Rajiv K. Varma.Wiley India.
4. FACTS Modeling and Simulation in Power Networks, Enrique Acha, Wiley India Distributed by BSP Books Pvt. Ltd.

#### Outcome:

After going through this course the student gets a thorough knowledge on, basics of HVDC system, converters control schemes harmonics filters reactive power control and power flow analysis in HVDC systems and basic concepts of FACTS, necessity of FACTS controllers and their operation, shunt and series compensation through various static compensators, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

### (A80238) NEURAL NETWORKS AND FUZZY LOGIC

(Elective-III)

#### Objective:

This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

#### UNIT – I:

**Introduction & Essentials to Neural Networks:** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

#### UNIT-II:

**Single & Multi Layer Feed Forward Neural Networks :** Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Credit Assignment Problem, Generalized Delta Rule, and Derivation of Back-propagation (BP) Training, Summary of Back-propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

#### UNIT-III:

**Associative Memories-I:** Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory).

#### UNIT-IV:

**Associative Memories-II:** Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hopfield

Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

#### UNIT – V:

**Fuzzy Logic: Classical & Fuzzy Sets:** Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

**Fuzzy Logic System Components:** Fuzzification, Membership value assignment, development of rule base and decision making system, De-fuzzification to crisp sets, De-fuzzification methods.

#### TEXT BOOKS:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, Rajasekharan and Pai, PHI.
2. Neural Networks and Fuzzy Logic, C. Naga Bhaskar, G. Vijay Kumar, BS Publications.

#### REFERENCE BOOKS:

1. Artificial Neural Networks, B. Yegnanarayana, PHI.
2. Artificial Neural Networks, Zaruda, PHI.
3. Neural Networks and Fuzzy Logic System, Bart Kosko, PHI.
4. Fuzzy Logic and Neural Networks, M. Amirthavalli, Scitech Publications India Pvt. Ltd.
5. Neural Networks, James A Freeman and Davis Skapura, Pearson Education.
6. Neural networks by satish Kumar , TMH, 2004
7. Neural Networks, Simon Hakins , Pearson Education.
8. Neural Engineering, C.Eliasmith and CH.Anderson, PHI.

#### Outcome:

After going through this course the student gets a thorough knowledge on , biological neurons and artificial neurons, comparative analysis between human and computer, artificial neural network models, characteristics of ANN's, different types of activation functions, learning strategies, learning rules, perceptron models, single and multi layer feed-forward and feed-back neural networks, back-propagation algorithm, Kolmogorov Theorem, different types of associative memories and basics of fuzzy logic, concept of classical and fuzzy sets, fuzzy logic system components fuzzification and defuzzification, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. EEE-II Sem L T/P/D C  
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### (A80324) RENEWABLE ENERGY SOURCES

#### (Elective-III)

#### Objective:

It introduces solar energy its radiation, collection, storage and application. It also introduces the Wind energy, Biomass energy, geothermal energy and ocean energy as alternative energy sources.

#### UNIT – I:

**Principles of solar radiation:** Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

#### UNIT-II:

**Solar Energy Collection, Storage & Applications: Collection:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**Storage & Applications:** Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

#### UNIT-III:

**Wind Energy:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

**Bio-Mass:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

#### UNIT-IV:

**Geothermal Energy:** Resources, types of wells, methods of harnessing the energy, potential in India.

**Ocean Energy:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

#### UNIT-V:

**Direct Energy Conversion:** Need for DEC, Carnot cycle, limitations, and principles of DEC.

## TEXT BOOKS:

1. Non-Conventional Energy Sources, G.D. Rai, Khanna Publishers.
2. Introduction to renewable energy, Vaughn Nelson, CRC Press (Taylor & Francis).

## REFERENCE BOOKS:

1. Renewable Energy Resources, Twidell & Wier, CRC Press (Taylor & Francis).
2. Renewable Energy Sources and Emerging Technologies, D. P. Kothari, K. C. Singal, Rakesh Ranjan, PHI Learning Private Limited.
3. Fundamentals of Renewable Energy Systems, D. Mukherjee, S. Chakrabarti, New Age International.
4. Renewable Energy Power for a sustainable Future, Godfrey Boyle, Oxford University Press.
5. Renewable energy resources, Tiwari and Ghosal, Narosa publications.
6. Renewable Energy Technologies, Ramesh & Kumar, Narosa publications.
7. Non-Conventional Energy Systems, K Mittal, Wheeler publications.

## Outcome:

After going through this course the student gets a thorough knowledge on , various types of renewable energy sources i.e. solar, wind, bio-mass, geothermal, ocean , hybrid energy systems and principles of direct energy conversion, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

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### (A80244) PRINCIPLES OF RELIABILITY ENGINEERING

#### (Elective-III)

#### Objective:

This subject introduces the concept of probability, reliability, distribution functions, and various methods and techniques to calculate and estimate the reliability of different engineering problems and models.

#### UNIT – I:

**Basics of Probability Theory & Distribution:** Basic probability theory – rules for combining probabilities of events – Bernoulli's trials – probabilities density and distribution functions – binomial distribution – expected value and standard deviation of binomial distribution.

#### UNIT – II:

**Network Modeling & Reliability Analysis:** Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method.

#### UNIT-III:

**Reliability Functions:**  $f(t)$ ,  $F(t)$ ,  $R(t)$ ,  $h(t)$  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 – IV:

**Markov Modeling:** 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.

#### UNIT – V:

**Frequency & Duration Techniques:** 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 of merged states.

## TEXT BOOK:

1. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India by B.S.Publications, 2007.

## Outcome:

After going through this course the student gets a thorough knowledge on, basic probability theory, distribution functions, reliability analysis of various models through different methods, reliability functions, repairable irreparable systems reliability through markov modeling frequency and duration techniques, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

### (A80234) ADVANCED CONTROL SYSTEMS

(Elective – IV)

#### Objective:

This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

#### UNIT – I:

**Stability Analysis-I: Frequency Domain:** Polar Plots-Nyquist Plots-Stability Analysis. Lag, Lead, Lead-Lag Controllers design in frequency Domain.

#### UNIT –II: S

**Stability Analysis-II:** Stability in the sense of Lyapunov. Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.

#### UNIT –III:

**Phase-Plane Analysis:** Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

#### UNIT – IV:

**Describing Function Analysis:** Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.

#### UNIT – V:

**State Space Analysis of Continuous Systems:** Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

#### TEXT BOOKS:

1. Advanced Control Systems, B. N. Sarkar, PHI Learning Private Limited.
2. Advanced Control Theory, Somanath Majhi, Cengage Learning.

#### REFERENCE BOOKS:

1. Control Systems theory and applications, S.K Bhattacharya, Pearson.
2. Control Systems, N.C.Jagan, BS Publications.
3. Control systems, A.Ananad Kumar, PHI.

4. Control Systems Engineering, S.Palani, Tata-McGraw-Hill.
5. Control systems, Dhanesh N.Manik, Cengage Learning.
6. Control Systems Engineering, I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers.
7. Control Systems, N.K.Sinha, New Age International (P) Limited Publishers.
8. Modern Control Engineering, Yaduvir Singh, S. Janardhanan, Cengage Learning.
9. Modern Control Engineering, K. Ogata, Prentice Hall of India, 3<sup>rd</sup> edition, 1998.
10. Modern Control System Theory, M. Gopal, New Age International Publishers.
11. Modern Control Engineering, D. Roy Choudhury, PHI Learning.
12. Digital Control and State Variable Methods, M. Gopal, Tata Mc Graw-Hill Companies.

#### Outcome:

After going through this course the student gets a thorough knowledge on , , basics of advanced control systems, stability analysis of control systems in frequency domain through polar & nyquist plots , design of lag, lead, lag-lead compensators in frequency domain, stability analysis through lyapunov stability , phase-plane analysis, non-linear systems , describing functions ,state space analysis of continuous systems and concept of controllability and observability, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

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### (A80235) EHV AC TRANSMISSION

#### (Elective-IV)

#### Objective:

This course introduces the concepts of extra high voltage AC transmission. It also emphasis on the behavior of the line parameters for extra high voltages, voltage gradients of the transmission line conductors gradients, the effect of corona, electrostatic filed calculations, travelling wave theory concept, voltage control when the line carries extra high voltages.

#### UNIT – I:

**Introduction :** Necessity of EHV AC transmission – advantages and problems–power handling capacity and line losses- mechanical considerations – resistance of conductors – properties of bundled conductors – bundle spacing and bundle radius- Examples.

**Line and ground reactive parameters:** Line inductance and capacitances – sequence inductances and capacitances – modes of propagation – ground return - Examples

#### UNIT – II:

**Voltage Gradients of Conductors:** Electrostatics – field of sphere gap – field of line changes and properties – charge – potential relations for multi-conductors – surface voltage gradient on conductors – distribution of voltage gradient on sub-conductors of bundle – Examples.

#### UNIT – III:

**Corona Effects:** Power loss and audible noise (AN) – corona loss formulae – charge voltage diagram – generation, characteristics - limits and measurements of AN – relation between 1-phase and 3-phase AN levels – Examples. Radio interference (RI) - corona pulses generation, properties, limits – frequency spectrum – modes of propagation – excitation function – measurement of RI, RIV and excitation functions – Examples.

#### UNIT – IV:

**Electro Static Field:** Electrostatic field: calculation of electrostatic field of EHV/AC lines – effect on humans, animals and plants – electrostatic induction in unenergized circuit of double-circuit line – electromagnetic interference-Examples.

**Traveling wave theory:** Traveling wave expression and solution- source of excitation- terminal conditions- open circuited and short-circuited end-reflection and refraction coefficients-Lumped parameters of distributed lines-

generalized constants-No load voltage conditions and charging current.

#### UNIT –V:

**Voltage Control:** Power circle diagram and its use – voltage control using synchronous condensers – cascade connection of shunt and series compensation – sub synchronous resonance in series capacitor – compensated lines – static VAR compensating system.

#### TEXT BOOKS:

1. EHVAC Transmission Engineering by R. D. Begamudre, New Age International (p) Ltd.
2. HVAC and DC Transmission by S. Rao.

#### REFERENCE BOOKS:

1. Rokosh Das Begamudre, "Extra High Voltage AC Transmission Engineering"– Wiley Eastern LTD.
2. Edison, "EHV Transmission line"- Electric Institution.

#### Outcome:

After going through this course the student gets a thorough knowledge on, general aspects and necessity of extra high voltage (EHVAC) transmission, advantages and disadvantages of EHVAC, concepts of voltage gradient, effects of corona, electro static field calculations, theory of travelling waves and voltage control of EHVAC transmission, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

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### (A82909) NANO TECHNOLOGY (Elective-IV)

#### Objective:

Nano-Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engineering. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

#### UNIT-I:

**Introduction:** History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

#### UNIT-II:

**Unique Properties Of Nanomaterials: Microstructure and Defects in Nano-crystalline Materials:** Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations, **Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility, **Magnetic Properties:** Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

#### UNIT-III:

**Synthesis Routes: Bottom up approaches:** Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders:** Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

#### UNIT-IV:

**Tools to Characterize Nanomaterials:** X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.



**UNIT-V:**

**Applications of Nanomaterials:** Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.

**TEXT BOOKS:**

1. Text Book of Nano Science and Nano Technology, B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology, Charles P. Poole, Jr., and Frank J. Owens, Wiley India.

**REFERENCES BOOKS:**

1. Nano: The Essentials, T.Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design, Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek.
3. Transport in Nano structures, David Ferry, Cambridge University press.
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact, Ed. Challa S.S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications, Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems, S. Dutta, Cambridge University press.

**Outcome:**

The present syllabus of "Introduction to Nano Technology" will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

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IV Year B.Tech. EEE-II Sem

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**(A80087) INDUSTRY ORIENTED MINI PROJECT****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

IV Year B.Tech. EEE-II Sem

L	T/P/D	C
-	-/6-	2

**(A80089) SEMINAR****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

IV Year B.Tech. EEE-II Sem

L	T/P/D	C
-	-/15/-	10

**(A80088) PROJECT WORK****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

IV Year B.Tech. EEE-II Sem

L	T/P/D	C
-	-/-	2

**(A80090) COMPREHENSIVE VIVA**