



**JIS College of Engineering**  
**(Autonomous)**  
**Department of Electrical Engineering**

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**COMMON CURRICULUM**

*for*

**Master of Technology (M.Tech) in**  
***Electrical Devices and Power Systems (EDPS)***

**1<sup>st</sup> Semester**

**Theory:**

Sl.No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
1.	EAM 101	Advanced Engineering Mathematics	3	1	0	4	4
2.	EDPM 102	Advanced Control System	3	1	0	4	4
3.	EDPM 103	Electrical Machine Analysis	4	0	0	4	4
4.	EDPM 104	Elective I (Any One) (a) Signal Processing (b) Power System Planning & Reliability	4	0	0	4	4
5.	EDPM 105	Elective II (a) Power System Operation & Control	4	0	0	4	4
6.		<b>Total of Theory</b>				<b>20</b>	<b>20</b>

**Practical/ Sessional:**

Sl. No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
1.	EDPM 191	Laboratory I	0	0	3	3	2
2.	EDPM 192	Laboratory II	0	0	3	3	2
3.	EDPM 193	Seminar I	0	0	3	3	2
4.		<b>Total of Practical/ Sessional</b>				<b>9</b>	<b>6</b>
5.	<b>TOTAL OF 1st SEMESTER</b>		<b>18</b>	<b>02</b>	<b>09</b>	<b>29</b>	<b>26</b>

**2<sup>nd</sup> Semester****Theory:**

Sl.No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
1.	EDPM 201	EHV AC Power Transmission	3	1	0	4	4
2.	EDPM 202	Power System Dynamics	4	0	0	4	4
3.	EDPM 203	Power System Protection	3	1	0	4	4
4.	EDPM 204	Elective III (Any One) (a) Power Electronics (b) Soft Computing Techniques	4	0	0	4	4
5.	EDPM 205	Elective IV (a) High Voltage DC Transmission System	4	0	0	4	4
6.		<b>Total of Theory</b>				<b>20</b>	<b>20</b>

**Practical/ Sessional:**

Sl. No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
1.	EDPM 291	Laboratory III	0	0	3	3	2
2.	EDPM 292	Laboratory IV	0	0	3	3	2
3.	EDPM 281	Seminar II	0	0	3	3	2
4.	EDPM 282	Comprehensive Viva-Voce	0	0	0	0	4
5.		<b>Total of Practical/ Sessional</b>				<b>9</b>	<b>10</b>
6.		<b>TOTAL OF 2<sup>nd</sup> SEMESTER</b>	<b>18</b>	<b>02</b>	<b>09</b>	<b>29</b>	<b>30</b>

**3<sup>rd</sup> Semester****Theory:**

Sl.No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
1.	EMM 301	Introduction to Management	4	0	0	4	4
2.	EDPM 301	Elective V (Any One) (a) Generation of Non-Conventional Energy (b) Microprocessor & Microcontroller	4	0	0	4	4
3.		<b>Total of Theory</b>				<b>8</b>	<b>8</b>

**Sessional:**

Sl. No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
1.	EDPM 382	Pre-submission Defense of Dissertation	0	0	0	0	4
2.	EDPM 381	Dissertation (Part-I)	0	0	0	20	10

<b>3.</b>		<b>Total of Practical/ Sessional</b>				<b>20</b>	<b>14</b>
<b>4.</b>	<b>TOTAL OF 3<sup>rd</sup> SEMESTER</b>					<b>28</b>	<b>22</b>

### 4<sup>th</sup> Semester

**Sessional:**

Sl. No.	Paper Code	Paper Name	Contacts Periods per weeks			Total Contact Hrs	Credits
			L	T	P		
<b>1.</b>	EDPM 481	Dissertation (Completion)	0	0	0	24	14
<b>2.</b>	EDPM 482	Post Submission Defense of Dissertation	0	0	0	0	8
<b>3.</b>		<b>Total of Practical/ Sessional</b>				<b>24</b>	<b>22</b>
<b>4.</b>	<b>TOTAL OF 4<sup>th</sup> SEMESTER</b>					<b>24</b>	<b>22</b>

**Total Credits: 26+30+22+22=100**





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**1<sup>st</sup> Year 1st Semester Syllabus for**  
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**COMMON DETAILED SYLLABUS**

**Advanced Engineering Mathematics**

**EAM-101**

**Contact: 3L+1T**

**Credit: 4**

**Complex Variables:** Review of complex variables, Conformal mapping & transformations, Function of complex variables, Pole and singularity, Integration with respect to complex argument, Residues and basic theorems on residues.

**Numerical Analysis:** Introduction, Interpolation formulae, Difference equation, Roots of equations, Solution of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix eigen value and eigen vector problems.

**Optimization Technique:** Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus variation, Constrained Optimization, Lagrange multipliers, Gradient method, Dynamic programming.

**Linear Algebra:** Vector space, Linear dependence of vectors, basis, linear transformations, inner product space, rank and inverse of a matrix, solution of algebraic equations, consistency conditions, Eigen values and eigen vectors, Hermitian and Skew Hermitian matrices.

***References:***

1. John B. Conway, Functions of one complex variable, Springer International.
2. James Ward Brown & Ruel V. Churchill, Complex variable and application., Mc Graw Hill International edition .
3. John H. Mathews, Numerical Methods for Mathematics , science and Engineering, PHI
4. D.C. Sanyal and K. Das, A text Book of Numerical analysis, U.N. Dhar & Sons Pvt. Ltd.
5. S.S.Rao, Optimisation theory and application, Wiley Eastern limited  
Hoffman & Kunze. R, Linear Algebra, PHI.



## Advanced Control Systems

### EDPM 102

Contact: 3L+1T

Credits: 04

**Review of Modeling and Analysis of LTI Systems:** Modeling of physical Systems. Design specifications and performance indices, Motion control systems, Transportation lags. Approximation of time-delay functions., Sensitivity of control systems to parameter variations. Effects of disturbance of signals. Disturbance rejection.

**Analysis in state-space:** A perspective on state-space design. State variables. State models for physical systems. SISO and MIMO

systems. Solution of state equations. Transfer function. Eigenvalues and eigenvectors. Jacobian linearization technique. State transformations and diagonalisation. Transformation to phase-variable canonical form. Controllability and observability. Duality property. Stability.

**Introduction to Discrete-time Systems:** Basic elements of discrete-time control system. Z-transform and properties. Inverse Z-transform. Difference equation and its solution by Z-transform method. Z-transfer function. State diagram of digital systems. Time delay. Direct, cascade and parallel decomposition of Z-transfer functions.

**Feedback control design:** Continuous control design. Proportional, derivative and integral control action. PID controller tuning rules. Ziegler-Nichols method. Two degree of freedom control systems. Compensator design using Bode diagram in frequency response approach. Lag, Lead, Lag-lead compensator. Control law design for full state feedback by pole placement. Full order observer system. Observer based state feedback. Separation principal.

### **Non linear system:**

Classification and types of non-linearity. Phenomena peculiar to non-linear systems. Methods of analysis. Linearization based on Taylor's series expansion. Jacobian Linearization. Phase trajectory and its construction. Phase-plane analysis of linear and non-linear systems. Existence of limit cycles. Describing function of typical non-linearities. Stability analysis by DF method. Introduction to DIDF. Popov's circle criterion. Stability analysis by Lyapunov's indirect and direct methods, Lyapunov's theorem.

### **References:**

1. Ogata, K – Modern Control Engineering, PHI Learning
2. Kuo, B.C. – Automation Control Systems, Prentice Hall
3. Roy Choudhury, D – Modern Control Engineering, Prentice Hall
4. Nagrath, J. J. Gopal, M – Control System Engineering, New Age Pub.
5. Schulz, D.G. and Melsa, . L. – State Functions and Linear Control Systems, McGraw-Hill.
6. Stepheni, Shahian, Savant, Hostetler – Design of feedback control systems, Oxford University Press.
7. Vidyasagar- Nonlinear system analysis, Prentice-Hall.
8. Gibson, J.E.- Non linear system , Mc. Grawhill.
9. Gopal. M, Digital Control and State Variable Methods, TMH.



## **Electrical Machine Analysis**

### **EDPM 103**

**Contact: 4L**

**Credit: 4**

Matrix Analysis of Electrical machines and circuits. Power invariance transformations, Modeling & solutions. Generalized machine of first kind: quasi holonomic reference frame, impedance matrix, torque matrix, flux and current density matrices. Modeling DC machines: steady state and transient analysis, repulsion and universal machines, cross field generator. Matrix analysis of single and three phase transformer under steady state and transient conditions, rectifier. General theory of electrical machines in rotational frame: generalized machine of second kind, holonomic and nonholonomic reference frame, torque matrix, voltage and impedance matrix. Analysis of single phase and three phase induction machines, analysis using revolving field theory, sequence reference frame state space modeling of electrical machines, equivalent circuits, synchronous generator under sudden short circuit, generalized fault analysis.

### ***References:***

1. Generalized theory of Electrical Machine, DP Sengupta

## **Power System Planning & Reliability**

### **EDPM 104(b)**

**Contact: 4L**

**Credit: 4**

**Load Forecasting:** Load Forecasting Categories-Long term, Medium term, short term, very short term, applications of Load Forecasting, Factors Affecting Load Patterns, Medium and long term load forecasting methods- end use models, econometric models, statistical model based learning. Short Term Load Forecasting (STLF): Applications of Load Forecasting, methods-similar day approach, regression methods, time series, ANN, Expert systems, Fuzzy logic based method, support vector machines ANN architecture for STLF, Seasonal ANN, Adaptive Weight, Multiple-Day Forecast, STLF Using MATLAB'S ANN Toolbox, Training and Test Data, Stopping Criteria for Training Process, sensitivity analysis.

**Power System Reliability:** Basic Notions of Power System Reliability- sub systems, reliability indices, outage classification, value of reliability tools, Concepts and methodologies, power system structure, Reliability based planning in power systems, Effect of failures on power system, Planning criteria, Risk analysis in power system planning, multi-state systems.

**Basic Tools and Techniques:** Random processes methods & Markov models, Computation of power system reliability measures by using Markov reward models, Evaluation of reliability indices, Universal Generating Function (UGF) Method, Monte Carlo simulation.

**Reliability of Generation Systems:** Capacity outage calculations, reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion.



**Reliability Assessment for Elements of Transmission and Transformation Systems:** Reliability indices of substations based on the overload capability of the transformers, evaluation and analysis of substation configurations, Reliability analysis of protection systems for high voltage transmission lines.

***References:***

1. Markey operations in electric power systems Forecasting, Scheduling, and Risk Management, Shahidehpour M, Yamin H, Li z, John Willey & sons.
2. Reliability evaluation of power systems, Billinton R, Allan R (1996) Plenum Press New York.
3. Computational Methods in Power system Reliability, D. Elmakias, Springer-Verlag.

**Power System Operation & Control**

**EDPM 105 (a)**

**Contact: 4L**

**Credit: 4**

**Optimal Generation Scheduling:** Thermal System Dispatching with Network Losses Considered, The Lambda-Iteration Method, Gradient Methods of Economic Dispatch - Gradient Search, Newton's Method, Economic Dispatch with Piecewise Linear Cost Functions, Economic Dispatch Using Dynamic Programming, Base Point and Participation Factors, Economic Dispatch Versus Unit Commitment, Coordination Equations, Incremental Losses, and Penalty Factors, The **B** Matrix Loss Formula Exact Methods of Calculating Penalty Factors, Reference Bus Versus Load Center Penalty Factors Reference-Bus Penalty Factors Direct from the AC Power Flow

**Optimal Power flow:** Optimal var control problem, controllable variables- Transformer taps, Generator voltages, Switchable shunt capacitors and Reactors, Objective functions, network performance constraints, constraints on state variables, Mathematical formulation, Solution of the Optimal Power Flow- The Gradient Method, Newton's Method, Linear Sensitivity Analysis, Linear Programming Methods, Sensitivity Coefficients of an AC Network Model Linear Programming Method with Only Real Power Variables, Linear Programming with AC Power Flow Variables and Detailed Cost Functions, Security-Constrained Optimal Power Flow, Interior Point Algorithm, Bus Incremental Costs

**Load Frequency Control:** control area concept, Block diagram and LFC of an isolated power system, Governor droop characteristic, AGC, primary and secondary frequency control, LFC of inter-connected power systems, Modes of tie line operation-flat frequency, flat tie line, tie line with frequency bias, Area control error, State space representation of two area system

**State Estimation:** Types of estimators-static, dynamic, tracking estimators. Least Squares and Weighted Least squares estimation, formulation, solution techniques, Bad data identification and detection.

**Security Analysis:** Normal, Alert, emergency, Restoration states in a power system. Security analysis, Security assessment, Security monitoring and Security controls. Credible and incredible



contingencies, Contingency identification and Contingency ranking, Security. Calculation procedures.

**Deregulation:** What is deregulation? Background to deregulation and current situation, Benefits of a competitive electricity market.

***References:***

1. Power generation, operation, and control, Allen J. Wood, Bruce F, Wollenberg
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**1<sup>st</sup> Year 2<sup>nd</sup> Semester Syllabus for  
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**COMMON DETAILED SYLLABUS**

**EHV AC Power Transmission**

**EDPM 201**

**Contact: 4L**

**Credit: 4**

**Theory of Compensation:** Requirements in ac Power Transmission, Uncompensated Transmission Lines:Electrical parameters, solution of transmission line wave equation, surge impedance and natural loading,performance of open-circuit line (Ferranti effect), symmetrical line at no load, under excited operation of generators, uncompensated line under load-maximum power and stability considerations.Compensated transmission Lines: Functions and types of compensation-SIL compensation, line length compensation, compensation by sectioning, Passive and Active Compensators, switched compensation, effect on Transient Stability.

**Flexible AC transmission systems:** FACTS applications in power systems, Basic relationships for powerflowcontrol in transmission interconnection, Power Flow & Stability of a transmission interconnection,power-flow control through compensation, Voltage Control, Power Oscillation Damping, FACTS classification, Thyristor controlled devices- Thyristor controlled reactor (TCR) and Thyristor switched capacitors (TSC), SVC voltage source converter based devices- STATCOM, UPFC.

***References:***

1. Power Electronic control in Electrical systems, E. Acha, V.G. Agelidis, O Anaya-Lara, TJE Miller, NEWNES Power Engineering series, New Delhi
2. Reactive Power Control in Electric Systems, TJE Miller, John Wiley & sons 1982
3. Thyristor -based FACTS controllers for electrical transmission systems, R. Mohan Mathur, Rajiv K. Varma, John Wiley & sons
4. Flexible AC Transmission Systems: Modelling and Control, Xiao-Ping Zhang, Christian Rehtanz, Bikash Pal, Springer
5. Understanding FACTS: concepts and technology of Flexible AC transmission systems, NG. Hingorani, Laszlo Gyugyi , John Wiley &sons



## Power System Dynamics

**EDPM 202**

**Contact: 4L**

**Credit: 4**

**Basic Concepts:** Basic structure of the power system, Power System Control requirements, Power system and Associated Controls Classification of Power System Dynamics, rotor angle, frequency and voltage instability, Extended Equal Area criterion, types of rotor angle instability-small signal & large signal stability. short term, mid-term and long term instabilities.

### **Modeling: Synchronous Machine**

Synchronous generator subjected to electromagnetic disturbance, reactances and time constants – Steady state operation, transient operation, sub transient operation, generator and system reference frame, Power, Torque and swing equation, synchronous generator model types. Advanced machine modeling-flux linkage equations in stator reference frame, flux linkage equations in rotor reference frame, power equations, voltage equations.

### **Excitation System**

Requirements, functions and elements of excitation system, Types and dynamic performance measures Control & protective functions, basic components, UEL, OEL and Power system stabilizer, basic block diagram derivation and IEEE model types for stability studies, Excitation system response, open-loop and closed-loop response.

### **Turbines and Governing systems**

Governor system basic building blocks, Hydraulic turbine-Governor-hydraulic system model, MHC and EHC Governors,

### **Load**

Static and dynamic load models

### **Dynamic Simulation:**

#### **Large signal stability:**

#### **Time domain Simulation**

Review of modified Euler, R-K Gill and trapezoidal methods, PE and SI methods, Transient stability enhancement.

#### **Energy Function Methods**

Physical & mathematical aspects, Lyapunov's method, Energy Function formulation, PEBS method for estimating region of attraction.

#### **Small signal stability:**

Fundamental concepts-stability of dynamic systems, Eigen properties of state matrix, SSS of SMIB classical model, effect of field circuit dynamics, effects of excitation system and PSS, SSS of multimachine and large systems.

#### **Voltage Stability:**

Voltage instability, Voltage collapse -phenomena, Transmission line characteristic, Factors influencing voltage stability, Voltage stability analysis methods.

### **References:**

1. Power System Stability and Control, Prabha Kundur, McGraw- Hill 1994  
Power System Dynamics and Stability, P.W. Saur & M.A. Pai, Prentice Hall 1998
2. Power System Dynamics Stability and Control, K.R.Padiyar, John Wiley & Sons 1996
3. Power System Oscillations, GJ Rogers, Kluwer Academic Publishers 1999
4. Power system Voltage stability, Carson W. Taylor, McGraw- Hill ,1994



## Power System Protection

**EDPM 203**

**Contact: 4L**

**Credit: 4**

**Introduction:** Relay types & Fault detection principles, CT & PT specification, Sequence filters  
**Non-Pilot over current protection:** principles, Time and/or current grading co-ordination, Directional over current relaying

**Differential protection:** principles, CT requirements

**Non-Pilot Distance Protection:** stepped distance protection principles, distance relay types & polar characteristics, phase relays and poly phase relays, distance relay performance and SIR, power swing blocking, distance schemes, under reach and over reach, protection of parallel and multiended feeders.

**Pilot-Distance-protection:** Communication channels, Tripping and blocking modes, directional comparison blocking and unblocking, under reaching transfer trip, PUR/POR transfer trip, phase comparison.

**Single and three pole auto reclosing in HV and EHV transmission systems.**

**Bus protection:** High & moderately high impedance relaying, CT requirements

**Unit Protection of Feeder:** Feeder differential protection, including pilot wire, current differential and phase comparison schemes

**Protection of transformers:** including biased and high impedance differential schemes, CT connections, 2 & 3 point differential protection, earthing transformers

**Protection of high voltage capacitor banks:** including consideration of inrush currents, over current, over voltage, and differential protection schemes

**Protection of large motors:** including differential and earth fault protection, thermal overload considerations, starting and stalling currents and the effect of negative phase sequence currents

**Protection of large generators:** including stator & rotor earth fault protection, biased differential, high impedance differential, negative sequence, under frequency, over/under excitation, reverse power and out of- step protections.

### *References:*

1. Power System Relaying, Stanley H. Horowitz, Arun G. Phadke, John Wiley & Sons
2. Protective Relays Application & Guide, GEC measurements
3. Power system protection, PM Anderson, IEEE Press book

## Power Electronics

**EDPM 204(a)**

**Contact: 3L+1T**

**Credit: 4**

**Review:** Principle of operation of IGBT, GTO, Thyristor family, Principle of operation of SCR, Characteristics, Construction, Rating, Turn on and turn off of a SCR, Phase controlled converters, performance analysis continuous and discontinuous mode of operation.

**DC-DC converters:** step down, step up, switching mode regulators, multi output boost converter, chopper circuit design, state space analysis of regulators



**Pulse-Width-Modulated Inverters:** performance parameters, advanced modulation techniques, voltage control of three phase inverters, harmonic reduction, current source inverters, variable DC-link inverter, inverter circuit design.

**Resonant Pulse Inverters:** series-resonant inverter frequency response, parallel-resonant inverters, voltage control of resonant inverters, ZCS and ZVS resonant converters, resonant DC-link inverters.

**Multilevel Inverters:** multilevel concept, Types of multilevel inverters: diode clamped, flying capacitor, cascaded, applications, switching device currents, DC-link capacitor voltage balancing.

**Isolated Switching DC Power Supplies:** Comparison between linear & switching power supply, Specification of SMPS, Different topologies, Flyback, Forward, Push –Pull, Half and Full Bridge), Control requirements and techniques, Practical SMPS design considerations, Protection

**Power Conditioners and Uninterruptible Power Supplies:** Power line disturbances, Power Conditioners. UPS & other residential and industrial applications.

### **References:**

1. Power Electronics Circuits, Devices, and Applications, MH Rashid, 3rd edition, Pearson Education.
2. Robbins, Undeland Mohanand, *Power Electronics*, John Willey & Son's.
3. Cyril W Lander, *Power Electronics*, Mchraw-Hill International Editions, 1993.
4. Philip T. Krein, *Power Electronics*. Oxford university press, 1997.
5. B. K. Bose, *Modern Power Electronics & AC Drives*, Prentice-Hall, 1986.
6. Singh, and Khanchandani, *Power Electronics*, India: Tata McGraw-Hill, 1981.

## **Soft Computing Techniques**

### **EDPM 204(b)**

**Contact: 4L**

**Credit: 4**

#### **Module 1**

Introduction to Soft Computing, components of soft computing, traditional computing and drawbacks, advantages of soft computing techniques.

#### **Module 2**

Introduction to fuzzy logic: definition, general idea and importance in practical life. Fuzzy set theory: concept of fuzzy set, membership functions, comparison of fuzzy set and classical set.

Operations on fuzzy sets, properties of standard operations, T norm and S norm, Extension principle and application. Height of fuzzy set, core of fuzzy set, support of fuzzy set, normal fuzzy set, normalization of fuzzy set, level set,  $\alpha$  cut and strong  $\alpha$  cut of fuzzy set, concentration and dilation of fuzzy sets, fuzzy singleton, crossover points.

**Fuzzy relation:** fundamentals of fuzzy relations, operations on fuzzy relations, composition of fuzzy relations, fuzzy reasoning, fuzzy relation inferences, compositional rule of inference, fuzzification. Fuzzy methods in control theory: Introduction to fuzzy logic controller, types of fuzzy logic controllers, basic structure of fuzzy knowledge based controllers, defuzzification methods, applications of fuzzy logic control.



### **Module 3**

Introduction to artificial neural networks, artificial neuron model, types of activation functions. Learning in neural networks, feed forward and feedback neural networks, backpropagation training algorithm, Hopfield network, Boltzman machine. Self organizing map, learning vector quantization algorithm.

### **Module 4**

Basic concept of genetic algorithm, comparison of GA and traditional techniques, objective function and fitness function, crossover, mutation, GA search, applications of GA.

### **Reference Books:**

1. Klir, G.J. & Yuan, B.- Fuzzy sets and Fuzzy logic, theory and applications, Prentice Hall of India Private Limited.
2. M. Ganesh - Introduction to fuzzy sets and fuzzy logic, PHI.
3. N. P. Padhy – Artificial intelligence and intelligent systems, Oxford
4. Timothy J. Ross – Fuzzy logic with engineering applications, Wiley.
5. Nie and Linkens,- Fuzzy Neural Control-Principles, Algorithms and Application, PHI
6. J.S.R. Jang, C.T. Sun, E. Mizutani - Neuro-fuzzy and soft computing, PHI.
7. Kosco, B.-Neural Networks and Fuzzy System.PH
8. Haykin- Neural Network; A Comprehensive Foundation, PHI
9. Rajasekaran and Pai – Neural Networks , Fuzzy Logic and Genetic algorithms: Synthesis and Application, PHI.
10. Goldberg- Genetic Algorithms, Pearson.

## **High Voltage DC Transmission**

### **EDPM 205(a)**

**Credit: 4L**

**Credits: 04**

**INTRODUCTION:** Introduction to AC and DC Transmission – application of DC Transmission – description of DC transmission – DC system components and their functions – modern trends in DC Transmission

**CONVERTER: Pulse Number** – Converter configuration – analysis of Graetz circuit – converter bridge characteristics – characteristics of 12 Pulse converter

**HVDC CONTROLLERS:** General principle of DC link control – converter control characteristics – system control hierarchy – firing angle control – current and extinction angle control – Dc link power control – high level controllers

**FILTERS:** Introduction to harmonics – generation of harmonics – design of AC filters – DC filters – carrier frequency and RI noise

**PROTECTION:** Basics of protection – DC reactors – voltage and current oscillations – circuit breakers – over voltage protection – switching surges – lightning surges – lightning arresters for DC systems

### **Reference Books:**

1. Kimbark, “Direct Current Transmission – Vol. I”, John Wiley and Sons Inc., New York, 1971

2. Padiyar. K. R., “HVDC Power Transmission Systems”, Wiley Eastern Limited, New Delhi, 2000.
  3. Arrillaga. J, “High Voltage Direct Current Transmission”, Peter Peregrines, London, 1983.
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**2nd Year 3rd Semester Syllabus for**  
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**COMMON DETAILED SYLLABUS**

**Generation of Non-conventional Energy**

**EDPM 301(a)**

**Contact: 3L+1T**

**Credits: 04**

**Introduction to Solar and Wind Energy:** Recent trends in energy consumption – World energy scenario – Energy sources and their availability – Conventional and renewable sources – Need to develop new energy technologies – Solar radiation and measurement – Solar cells and their characteristics – Influence of insulation and temperature – PV arrays – Electrical storage with batteries – Solar availability in India – Switching devices for solar energy conversion – Stand alone inverters – Charge controllers – Water pumping – Audio visual equipments, Street lighting, Analysis of PV systems.

**Power Conditioning Converters:** DC Power conditioning converters – Maximum Power point tracking algorithms – AC power conditioners – Line commutated inverters – synchronized operation with grid supply – Harmonic problem

**Wind Energy Conversion System:** Basic principle of wind energy conversion – nature of wind – Wind survey in India – Power in the wind – components of a wind energy conversion system – Performance of Induction Generators for WECS – Classification of WECS

**Induction Generator:** Self excited Induction Generator for isolated Power Generators – Theory of self e excitation – Capacitance requirements – Power conditioning schemes – Controllable DC Power from SEIGs

**Optimization Technique:** Wind / Solar PV integrated systems – selection of power conversion ratio – Optimization of system components – Storage.

**References:**

1. Rai G.D., “Non – Conventional Energy Sources”, Khanna Publishers, 1993.
2. Rai G.D., “Solar Energy Utilisation”, Khanna Publishers, 1993.
3. Daniel, Hunt V, “Wind Power – A Handbook of WECS”, Van Nostrend Co., New York, 1981.
4. Gary L. Johnson, “Wind Energy Systems”, Prentice Hall Inc., 1985.
5. Freris L. L., “Wind Energy Conversion”, Prentice Hall (UK) Ltd., 1990.





## Microprocessor & Microcontroller

**EDPM 301(b)**

**Contact: 4L**

**Credit: 4**

**Intel 8086:** Architecture and organization, registers structure, memory addressing, minimum and maximum mode of operation, interrupt structure, hardware, and software interrupt vector table.

**Instruction set of 8086:** Arithmetic and logical instruction, bit manipulation instruction, process control instruction, programming example, microprogramming.

**Controllers:** PPI 8255- mode zero, mode one, mode two, bsr, interrupt controller 8259, DMA controller 8237.

**CISC and RISC system:** structure of a typical CISC microprocessor, Pentium process register structure, integer pipe lines, flags

**Applications:** Machine control- traffic light and washing machine controller.

**Micro controller:** Architectures and organization of 8031/8051, programming technique, interfacing and applications.

### ***References:***

1. Advanced Microprocessor (1st edition) , Y Rajasree, New age international
2. Microprocessor, microcomputer and their applications (3rd edition), AK Mukhopadya, Narosa Publishers.
3. Microprocessor based laboratory experiments and projects (2nd Edition), AK Mukhopadya, S. Ratan & Co.