SYLLABUS

FOR

SEMESTER THIRD

Course Code	**PEC1PSC301**			**Semester**	**Third**
Category	**Professional Core Course(PEIII)**				
Course Title	**Artificial Intelligence**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:-

1. Understanding fuzzy logic, ANN
2. Understanding GA & EP

Unit	Content
1.	Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks
2.	Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods
3.	Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA
4.	System Identification using Fuzzy and Neural Network
5.	Genetic algorithm, Reproduction crossover, mutation, Introduction to evolutionary program
6.	Applications of above mentioned techniques to practical problems

Textbooks:

1. J M Zurada , “An Introduction to ANN”,Jaico Publishing House
2. Simon Haykins, “Neural Networks”, Prentice Hall
3. Timothy Ross, “Fuzzy Logic with Engg.Applications”, McGraw. Hill
4. Driankov, Dimitra, “An Introduction to Fuzzy Control”, Narosa Publication
5. Golding, “Genetic Algorithms”, Addison-Wesley Publishing Com

Course Code	PEC2PSC301			Semester	Third
Category	Professional Core Course(PEIII)				
Course Title	Power System Transients				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Power System				

Course Objectives:

1. Learn the reasons for occurrence of transients in a power system
2. Understand the change in parameters like voltage & frequency during transients
3. To know about the lightning phenomenon and its effect on power system

Unit	Content
1.	Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits-Abnormal switching transients, Three-phase circuits and transients,Computation of power system transients
2.	Principle of digital computation – Matrix method of solution, Modal analysis- Z transform-Computation using EMTP, Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.
3.	Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault Energizing transients - closing and Re-closing of lines, line dropping, load rejection – over voltages induced by faults
4.	Switching HVDC lineTravelling waves on transmission line, Circuits with distributed Parameters Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion Multi-conductor system and Velocity wave
5.	Insulation coordination: Principle of insulation coordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Co- ordination between insulation and protection level, Statistical approach
6.	Protective devices: Protection of system against over voltages, lightning arresters, substation earthing

Textbooks:

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991

Course Code	PEC3PSC301			Semester	Third
Category	Professional Core Course(PEIII)				
Course Title	FACTS				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Objectives:-

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

Unit	Content
1.	Introduction to FACTS Technology, Types of FACTS controller, FACTS vs. HVDC, Benefits of FACTS Technology,Performance Equations and Parameters of Transmission Lines,Transfer of Active and Reactive Power over a Transmission Line,Uncompensated Transmission, Need for Compensation, Definition and Functions of compensation.
2.	Compensation Techniques: Ideal Shunt compensation, Ideal Series compensation, Phase-Angle control (Regulator),Advantages of Series compensation (voltage support, Transient stability improvement, Power oscillation damping), Advantages of shunt compensation, Thyristor Controlled Reactor (TCR), Thyristor-Switched Capacitor (TSC).
3.	Analysis of various types of Static Var compensators (SVC),Static Synchronous Compensator (STATCOM): Analysis and comparison with SVC, STATCOM convertors (Multi-level VSIs for STATCOM applications),Series compensators: GTO-Controlled Series Capacitor (GCSC),Thyristor-Switched Series Capacitor (TSSC), Thyristor-Controlled Series Capacitor (TCSC),Static Synchronous Series Compensator (SSSC).
4.	Voltage & Phase-Angle Regulation,Thyristor-Controlled Voltage Regulator (TCVR), Thyristor Controlled Phase-Angle Regulator (TCPAR)
5.	Series-Shunt compensator: Unified Power Flow Controller (UPFC),Series-Series compensator: Interline Power Flow Controller (IPFC) ,Thyristor Controlled Braking Resistor (TCBR), Modeling of some FACTS controllers.

Textbooks:

1. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, SpringerVerlag, Berlin, 2006
3. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar ,S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda DigitalLibrary, NIT Calicut,2003

Course Code	PEC4PSC301			Semester	Third
Category	Professional Core Course(PEIII)				
Course Title	Industrial Load Modeling and Control				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:-

1. To understand the energy demand scenario
2. To understand the modeling of load and its ease to study load demand industrially
3. To know Electricity pricing models
4. Study Reactive power management in Industries

Unit	Content
1.	Electric Energy Scenario-Demand Side Management-Industrial Load Management Load Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of Industrial Loads, Continuous and Batch processes -Load Modeling
2.	Electricity pricing – Dynamic and spot pricing -Models, Direct load control- Interruptible load control, Bottom up approach- scheduling- Formulation of load Models,Optimization and control algorithms - Case studies
3.	Reactive power management in industries, controls-power quality impact, application of filters Energy saving in industries
4.	Cooling and heating loads
5.	load profiling, Modeling- Cool storage, Types-Control strategies, Optimal operation,Problem formulation- Case studies
6.	Captive power units, Operating and control strategies, Power Pooling- Operation models, Energy banking, Industrial Cogeneration

Textbooks:

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J. Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hillpublishers, NewDelhi, 1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA

Course Code	**PEC5PSC301**			**Semester**	**Third**
Category	**Professional Core Course(PEIII)**				
Course Title	**Optimal Control**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:-

1. To know the operation of closed and open loop optimal control.
2. Understand the adaptive control strategies.
3. Learn dynamic programming methods.

Unit	Content
1.	Introduction and Review of Basic Concepts,Introduction, Motivation and Overview Overview of SSApproach and Matrix Theory, Review of Numerical Methods
2.	Static Optimization
3.	Optimal Control through Calculus of Variation
4.	Classical Numerical Techniques for Optimal Control
5.	Linear Quadratic Regulator (LQR) Theory
6.	Optimal Missile Guidance, Linear Optimal Missile Guidance using LQR
7.	LQ Observer and Kalman Filter Design, Linear Quadratic Observer & An Overview of State Estimation, Review of Probability Theory and Random Variables, Kalman Filter Design

Textbooks:

1. Donald E. Kirk, “Optimal Control Theory, An introduction”, Prentice Hall Inc., 2004
2. A.P. Sage, “Optimum Systems Control”, Prentice Hall, 1977
3. HSU and Meyer , “Modern Control, Principles and Applications”, McGraw Hill, 1968
4. Yoan D. Landu, “Adaptive Control (Model Reference Approach)”, Marcel Dekker. 1981
5. K.K.D.Young, “Design of Variable Structure Model Following Control Systems”, IEEE Transactions on Automatic Control, Vol. 23, pp 1079-1085, 1978.

Course Code	**PEC6PSC301**			**Semester**	**Third**
Category	**Professional Core Course(PEIII)**				
Course Title	**HVDC**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:-

1. Understand the advantages of dc transmission over ac transmission.
2. Understand the operation of Line Commutated Converters and Voltage Source Converters.
3. Understand the control strategies used in HVDC transmission systems.
4. Understand the improvement of power system stability using an HVDC system

Unit	Content
1.	Evolution of HVDC Transmission,Comparison of HVAC and HVDC systems,Type of HVDC Transmission systems, Components of HVDC transmission systems
2.	Analysis of simple rectifier circuits, Required features of rectification circuits for HVDC transmission, Analysis of HVDC converter. a. Different modes of converter operation. b. Output voltage waveforms and DC voltage in rectification. c. Output voltage waveforms and DC in inverter operation. d. Thyristor voltages.
3.	HVDC system control features. Control Modes. Control Schemes. Control comparisons.
4.	Converter mal-operations.Commutation failure. Starting and shutting down the converter bridge. Converter protection.
5.	Smoothing reactor.Reactive power requirements. Harmonic analysis. Filter design.
6.	Power flow analysis of AC-DC systems.
7.	Multi-terminal HVDC system. Advances in HVDC transmission.

Textbooks:

1. HVDC Power Transmission Systems, K.R. Padiyar, New Age International
2. Power System Stability and control, Prabha Kundur, Tata McGraw-Hill

Course Code	**OEC1PSC302**			**Semester**	**Third**
Category	**Professional Core Course(OE)**				
Course Title	**Python Data Analytics**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	3	**1**	**0**	**4**	
Prerequisites	**Nil**				

Course Objectives:-

1. To understand the importance of data science
2. To experience and apply Python's diverse array of packages

Unit	Content
1.	Introduction to data analytics, Python Fundamentals, Central Tendency and Dispersion Probability and Probability Distributions, Sampling and Sampling Distribution Confidence interval estimation
2.	Hypothesis Testing; Errors in Hypothesis Testing, ANOVA, Post Hoc Analysis, Randomized block design (RBD),Two Way ANOVA
3.	Linear Regression,Estimation, Prediction of Regression Model Residual Analysis MULTIPLE REGRESSION MODEL; Categorical variable regression
4.	Maximum Likelihood Estimation, LOGISTIC REGRESSION,Linear Regression Model Vs Logistic Regression Model, Confusion matrix and ROC, Performance of Logistic Model Regression Analysis Model Building
5.	Chi - Square Test of Independence, Chi-Square Goodness of Fit Test, Cluster analysis Energy banking, Industrial Cogeneration
6.	K- Means Clustering, Hierarchical method of clustering, Classification and Regression Trees, Measures of attribute selection

Textbooks:

1. Grus, Joel, "Data Science from Scratch: First Principles with Python ", O'Reilly Media, 2019
2. Wes Kinney, "Python for Data Analysis", O'Reilly Media, 2018
3. Abhishek Thakur, "Approaching (Almost) Any Machine Learning Problem", 2020
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2013

Course Code	OEC2PSC302			Semester	Third
Category	Professional Core Course(OE)				
Course Title	Waste to Energy				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:-

1. How waste can be used as fuel
2. Uses of Biomass

Unit	Content
1.	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
2.	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
3.	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.
4.	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.
5.	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 - Biodiesel production - Urban waste to energy conversion - Biomass energy programme in India.

Textbooks:-

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.

Course Code	OEC3PSC302			Semester	Third
Category	Professional Core Course(OE)				
Course Title	Composite Material				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:-

1. Have a deep understanding of composite materials
2. Understand about Manufacturing of polymer & metal matrix composites

Unit	Content
1.	INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
2.	REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.
3.	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.
4.	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.
5.	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs– hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Textbooks:

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.

Course Code	OEC4PSC302			Semester	Third
Category	Professional Core Course(OE)				
Course Title	Cost Management and Engineering Projects				
Scheme & Credits	L	T	P	Credits	Max Marks: 100
	3	1	0	4	
Prerequisites	Nil				

Course Objectives:-

1. Understand about the process of strategic cost management
2. Decision making , role of project teams in projects, cost behaviour & profit planning

Unit	Content
1.	Introduction and Overview of the Strategic Cost Management Process
2.	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
3.	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as a conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents
4.	Project team : Role of each member. Importance Project site : Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process
5.	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Cost of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management,
6.	Benchmarking; Balanced Scorecard and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Textbooks:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Code	**PCCPSC303**			**Semester**	**Third**
Category	**Professional Core Course**				
Course Title	**PYTHON LAB**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**4**	**2**	
Prerequisites	**Nil**				

List of Experiments:

S. No.	Experiment
1.	Introduction to Python:Plotting, Saving Scripts, Numpy Arrays, IPython Notebooks
2.	Basic Data Types, Control Flow, Core Data Structures
3.	Functions; Files and Modules; Exceptions
4.	Pandas experiments
5.	Data visualisation
6.	Case studies on classification
7.	Case studies on regression
8.	Text mining and modelling
9.	Case studies and experiments on social media sentiment analysis
10.	Experiments on browser automation and office-work optimisation

Course Code	**PCCPSC304**			**Semester**	**Third**
Category	**Programme Core Course**				
Course Title	**Phase – I Dissertation**				
Scheme & Credits	**L**	**T**	**P**	**Credits**	**Max Marks: 100**
	0	**0**	**16**	**8**	
Prerequisites	**All core courses**				

The Phase – I Dissertation work is carried out by an individual student. In this work, students shall choose a specific topic/area for the project. The selected areas shall encompass recent and emerging trends in technologies that prove beneficial for society in general and humanity in particular. Supervisors will be assigned to each student in the beginning of the 3rd semester of their course. Each student at the end of the course will submit a Project report and a working prototype or simulation regarding the project and the same will be evaluated for final award of the course. The Phase – I Dissertation can be a full-fledged project or a part of a Phase – II Dissertation.