SYLLABUS

Approved in 13th Meeting of Executive Council held on 27th March 2023 subsequent to the 14th Meeting of Academic Council held on 20th March 2023

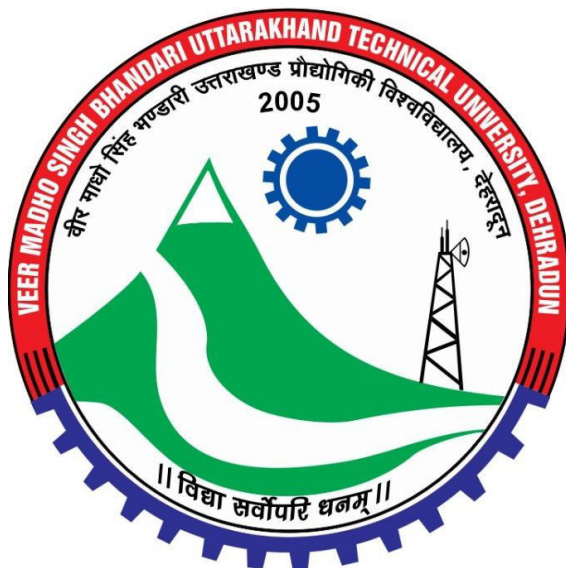**(For admission in 2022-23 and onwards)**

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

Master of Engineering Programmes
(M.TECH.-Electrical Engineering, 1st Year)

(For admission in 2022-23 and onwards)

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

[M.Tech. (Electrical Engineering) Curriculum Structure]

Semester-I (effective from 2022-23)

S. No.	Subject Codes	Subject Name	Periods			Sessional Exam			ESE		Subject Total	Credit
			L	T	P	CT	TA	Total	TE	PE		
1	(AHT-301)	Advanced Mathematics	3	1	0	30	20	50	100		150	4
2	(MEET101)	Advanced Power Electronics	3	1	0	30	20	50	100		150	4
3	(MEET102)	Advanced Control System	3	1	0	30	20	50	100		150	4
4	(MEET111) (MEET112) (MEET113)(MEET114)	1. Renewable Energy Systems 2. Power System Modeling 3. Applications of Power Electronics to Power Systems 4. Hybrid Electric Vehicles	3	0	0	30	20	50	100		150	3
5	(MEET121) (MEET122) (MEET123) (MEET124)	1. Power Electronics for Renewable Energy Systems 2. HVDC Transmission Systems 3. Modern Optimization Techniques 4. Advanced Digital Signal Processing	3	0	0	30	20	50	100		150	3
6	(MEEP101)	Advanced Power Electronics Lab	0	0	3		25	25		25	50	1
7	(MEEP102)	Advanced Control System Lab	0	0	3		25	25		25	50	1
8	(AHT-302)	Research Methodology and IPR	2	0	0		50	50	50		100	2
9	(AHT-303)	Technical Writing and Presentation Skill	2	0	0			50	0			0
		Total	19	3	6			400	600		950	22
10		*Open Elective-1(Optional)	3	0	0	30	20	50	100		150	3

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week,

CT-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance,

PS-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks,PE- Practical External Examination Marks

*Open Elective-1(Optional)
MOET-391: Industrial Internet of Things
MOET392: Neural Computing Systems and Applications
MOET393: Distributed Generation & Micro-Grids
MOET394: Fundamentals of Electric and Hybrid Vehicles

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN
[M.Tech. (Electrical Engineering) Curriculum Structure]

S. No.	Subject Codes	Subject Name	Periods			Sessional Exam			ESE		Subject Total	Credit
			L	T	P	CT	TA	Total	TE	PE		
		Semester-II (effective from 2022-23)										
1	(MEET201)	Digital Protection ofPower System	3	1	0	30	20	50	100		150	4
2	(MEET202)	Semiconductor ControlledDrives	3	1	0	30	20	50	100		150	4
3	(MEET231) (MEET232) (MEET233) (MEET234)	1. Restructured Power Systems 2.Energy Management and Auditing 3.Dynamics of Electrical Machines 4.Power Apparatus Design	3	1	0	30	20	50	100		150	4
4	(MEET241) (MEET242)(MEET243)(MEET244)	1. Advanced Micro-Controller Based Systems 2. SCADA system and Applications 3. Power Quality 4. Artificial Intelligence Techniques	3	0	0	30	20	50	100		150	3
5		Open Elective-1	3	0	0	30	20	50	100		150	3
6	(MEEP201)	Advanced Power System Protection Lab	0	0	3		25	25	25	25	50	1
7	(MEEP202)	Electric Drives Lab	0	0	3		25	25	25	25	50	1
		Total	**15**	**3**	**6**			**300**	**550**		950	
8		*Open Elective-2(Optional)	3	0	0	30	20	50	100		150	3

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week,

CT-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance,

PS-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks,

Open Elective-1	***Open Elective-2(Optional)**
MOET-391: Industrial Internet of Things	MOET-391: Industrial Internet of Things
MOET392: Neural Computing Systems and Applications	MOET392: Neural Computing Systems and Applications
MOET393: Distributed Generation & Micro-Grids	MOET393: Distributed Generation & Micro-Grids
MOET394: Fundamentals of Electric and Hybrid Vehicles	MOET394: Fundamentals of Electric and Hybrid Vehicles

Syllabus
Advanced Mathematics (AHT-301)

L:T:P:: 3:1:0   **Credits-4**

Course objectives:

From this course, students will be able to:
1. learn distinct methods of solving simultaneous equations.
2. well-versed with partial differential equations and their solutions and applications.
3. acquire the knowledge of transformation to ease the complex problems.
4. acquaintance with basics of random variables and their distribution for dealing with events by chance.
5. study different mathematical domains to deal with real-time engineering problems.

Learning outcomes:
1. Comprehend with engineering problems in different mathematical realm.
2. Learn analytical and numerical methods to deal with mathematical problems.
3. Understand how to model the engineering problems and their solutions.
4. Implement the solutions to real-time complex engineering problems.
5. Apprehend with mathematical methodology.

Course content:

Unit I: Solution of linear simultaneous equations: **(8 hours)**

Consistency, Iterative method, Convergence, Cholesky's (Crout's) method, Gauss-Jordan method, Gauss-Seidel iteration and relaxation methods, Solution of Eigenvalue problems, Smallest, largest, and intermediate Eigen values

Computer based algorithm and programme for these methods (non-evaluative)

Unit II: Partial differential equation and its applications: **(10 hours)**

Introduction and classification of partial differential equation, Four standard forms of non-linear partial differential equations and their solutions, linear equations with constant coefficients. Applications of partial differential equations, one and two-dimensional wave equation, one and two-dimensional heat equation, Two-dimensional Laplace's equation.

Syllabus
Advanced Mathematics (AHT-301)

L:T:P:: 3:1:0   **Credits-4**

Unit III: Transform calculus-I: **(8 hours)**

Laplace transform, Properties of Laplace transform, Inverse Laplace transform,Applications of Laplace transform, Fourier integral theorem, Fourier transforms, Application of Fourier transform

Unit IV: Transform calculus-II: **(8 hours)**

Z-transform, Properties of Z-transform, Shifting theorems, Initial and final value theorem, Convolution theorems, Inverse Z-transform, Application of Z-transform

Unit V: Basic probability theory: **(8 hours)**

Concept and laws of probability, Discrete and continuous random variable and their distributions; Some special distributions such as Binomial, Poisson, Negative Binomial, Geometric,Continuous uniform, Normal, Exponential, Weibull, Moments, Moment generating functions,Expectation and variance

Practical demo with statistical software like R, SPSS, SAS, etc. (non-evaluative)

Text Books / References:
1. B.S. Grewal, Engineering Mathematics, Khanna Publications, 44th edition.
2. F.B. Hilderbrand, Method of Applied Mathematics, PHI Publications, 2nd edition.
3. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publication, 20th edition.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathmematical Statistics, S. Chand Publication, 4th edition.
5. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th edition.
6. S. Ross, A First Course in Probability, Pearson Education, 8th edition.

Syllabus
Research Methodology and IPR (AHT-302)

L:T:P:: 2:0:0   **Credits-2**

Course Objectives: Students will be able to:
1. To understand the fundaments of research in today's world controlled by technology, ideas, concept, and creativity.
2. To understand different methods of research designing and data collections.
3. To understand the methods of report writing and its different methods of interpretations.
4. To understand research ethics and methods of research publications
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and inturnbrings about, economic growth and social benefits.

Course Outcomes:

1. To understand research problem formulation.
2. To study research design and method of data collections.
3. To study methods of report writing.
4. To follow research ethics.
5. To enhance student's competence to discover new inventions.

Syllabus Contents:

UNIT I: FUNDAMENTAL OF RESEARCH

Meaning of research; objectives of research; basic steps of research; criteria of good research; Research methods vs. Methodology. Types of research –criteria of good research; Meaning of research problem; selection of research problem; Approaches of investigation of solutions for researchproblem, Errors in selecting a research problem, Scope and objectives of research problem, Review of related literature- Meaning, necessity and sources.

Unit 2: RESEARCH DESIGN AND DATA COLLECTION

Research design: Types of research design- exploratory, descriptive, diagnostic and experimental;Variables- Meaning and types; Hypothesis- Meaning, function and types of hypothesis; Null/Alternative hypothesis; Sampling- Meaning and types of sampling; Probability and Non- Probability; Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc.

Unit 3: REPORT WRITING AND ITS INTERPRETATION

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

Syllabus
Research Methodology and IPR (AHT-302)

L:T:P:: 2:0:0   **Credits-2**

Unit 4:RESEARCH ETHICS AND SCHOLARY PUBLISHING

Ethics-ethical issues, ethical committees (human & animal); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism and its concept and importance for scholar.

Unit 5: INTELLECTUAL PROPERTY RIGHT (IPR)

IPR- intellectual property rights and patent law, commercialization, New developments in IPR; copy right, royalty, trade related aspects of intellectual property rights (TRIPS); Process of Patenting and Development; Procedure for grants of patents, Patenting under PCT;Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases.

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineering students'"
2. WayneGoddardandStuartMelville,"ResearchMethodology:AnIntroduction"
3. RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuideforbeginners"
4. Halbert,"ResistingIntellectualProperty",Taylor&FrancisLtd,2007.
5. Mayall,"IndustrialDesign",McGrawHill,1992.
6. Niebel,"ProductDesign",McGrawHill,1974.
7. Asimov,"IntroductiontoDesign",PrenticeHall,1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age",2016.
9. T.Ramappa,"IntellectualPropertyRightsUnderWTO",S.Chand,2008

Technical Writing and Presentation Skills (AHT-303) L:T:P::2:0:0

credit:00

Course Objectives:
- To develop effective writing and presentation skills in students.
- To develop textual, linguistic and presentation competencies instudents appropriate for their professional careers.

Course Outcomes:
After the successful completion of course, the students will be able to:

CO1: Write clearly and fluently to produce effective technical documents.

CO2: Demonstrate an appropriate communication style to different types of audiences both orally and written as per demand of their professional careers.

CO3: Communicate in an ethically responsible manner.

Course Contents:

WRITING SKILLS
Unit-I   **(4 hours)**
Technical Writing-Basic Principles: Words-Phrases-Sentences, Construction of Cohesive Paragraphs, Elements of Style.
Unit-II   **(4 hours)**
Principles of Summarizing: Abstract, Summary, Synopsis
Unit-III   **(6 hours)**
Technical Reports: Salient Features, Types of Reports, Structure of Reports, Data Collection, Use ofGraphic Aids, Drafting and Writing

PRESENTATION SKILLS
Unit-IV   **(6 hours)**
Speaking Skills: Accuracy vs. Fluency, The Audience, Pronunciation Guidelines, Voice Control.
Unit-V   **(8 hours)**
Professional Presentations: Planning, Preparing, Presentation Strategies, Overcoming, Communication Barriers, Using Technology, Effective Presentations.

References:

1. Kumar, Sanjay & Pushp Lata, "Communication Skills", Oxford UniversityPress,2011.
2. Quirk & Randolph, "A University Grammar of English", Pearson,2006.
3. Rutherford, Andrea J., "Basic Communication Skills for Technology", Pearson 2007.
4. Rizvi, M Ashraf, "Effective Technical Communication", McGraw Hill,2009.
5. Leigh, Andrew & Maynard, Michael, "The Perfect Presentation", Random House.
6. Barker, Larry L., "Communication", Prentice-Hall.
7. Lesikar & Flatley, "Basic Business Communication-Skills for Empowering the Internet Generation", Tata McGraw-Hill.

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus
ADVANCED POWER ELECTRONICS (MEET-101)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of the behaviour of power semiconductor devices operated as power switches, Analyse operation of DC-DC power converters. To familiarize with the inverter for different application, advance power conversion techniques, power conversion technology for exploring RES.

Course Outcomes:

At the end of course the student will be able to-
1. Explain the behaviour of power semiconductor devices operated as power switches.
2. Analyse operation of DC-DC power converters
3. Select inverter for different application
4. Adopt advance power conversion techniques
5. Apply power conversion technology for exploring RES

Syllabus:

UNIT-I   **(8 hours)**

Overview of Switching Power Devices:
Solid State Power Semi-conducting Devices: Review of the thyristors, TRIAC, GTO, transistors, BJT, MOSFET, IGBT, switching circuits for MOSFET and IGBT, SiC based MOSFETs

UNIT-II   **(8 hours)**

DC-DC Converters:
Non-isolated DC-DC converters: buck, boost, buck-boost
converters under continuous and discontinuous conduction operation. Isolated DC-DC converters: forward, fly-back, push-pull, half-bridge- and full-bridge converters. Sepic converter, Zeta converter

UNIT-III   **(8 hours)**

Inverters:
Three-phase inverters- 120° and 180° modes of operation- PWM techniques, space vector modulation, current source inverter, multi-level inverters, techniques for reduction of harmonics

UNIT-IV   **(8 hours)**

Advance Techniques
Advanced power conversion techniques, resonant power conversion, multilevel converters, Multi-pulse Converters, Controlled AC to DC Conversion.

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus
ADVANCED POWER ELECTRONICS (MEET-101)

L:T:P:: 3:1:0   **Credits-4**

UNIT-V   **(8 hours)**

Convertor for Non-Conventional Energy Sources
Power Electronics Controller for Wind Energy Electric Conversion Systems, Photo Voltaic Arrays, MPPT, energy saving in AC and DC Drives.

REFERENCES:

1. Power Electronics-circuits, Devices & Applications, M.H. Rashid : 3rd ed., PHI, 2005.

2. Power Electronics: Converters, Applications, Ned Mohan, T.M. Undeland, William P. Robbins: 3rd ed., John Wiley & Sons, 2009

Syllabus
ADVANCED CONTROL SYSTEM (MEET-102)

L:T:P:: 3:1:0 **Credits-4**

Course Objectives:

To explore the basic understanding of the dynamics of a linear system by State Space Representation, stability of a linear system using pole-placement technique. To familiarize with the optimal control problems in terms of performance indices and discrete time system and model its action mathematically.

Course Outcomes:

At the end of course the student will be able to-
1. Analyze dynamics of a linear system by State Space Representation.
2. Determine the stability of a linear system using pole-placement technique and Design state observers.
3. Analyze basics of Non-linear control system.
4. Formulate and solve deterministic optimal control problems in terms of performance indices.
5. Realize the structure of a discrete time system and model its action mathematically

Syllabus:

UNIT-I **(8 hours)**

State Space Models, State Diagram, State Space and State Trajectory, State Space, Representation using Phase Variable and Canonical Variables, Solution of State Equation, State Transition Matrix and its Properties, Eigen Values, Eigen Vectors, Model Matrix, Diagonalization, Generalized Eigen vectors, Computation of State Transition Matrix using Laplace Transformation, Power Series Method, Cayley-Hamilton Method, Similarity Transformation Method. Controllability and Observability Tests: Kalman's test, Gilbert's Test, Controllability and Observability Canonical Forms.

UNIT-II **(8 hours)**

POLE PLACEMENT TECHNIQUES Controller Design by State Feedback, Necessary and Sufficient Condition for Arbitrary Pole Placement-State Regulator Problem and State Regulator Design, Evaluation of State Feedback Gain Matrix K, Selection of Location of Desired Closed Loop Poles, State Observer Design, Full Order/Reduced Order Observer Design, Observer Based State Feedback Control, Separation Principle

UNIT-III **(8 hours)**

NONLINEAR CONTROL SYSTEM Introduction, Properties of Nonlinear System, Behavior of Non-Linear System, Classification of Nonlinearities, Common Physical Nonlinearities: Saturation, Friction, Backlash, Dead-Zone, Relay, On-Off Nonlinearity, Nonlinear Spring, Limit cycle, Jump resonance. Phase-Plane Method, Singular points, Stability of Nonlinear System, Construction of Phase Trajectories, Describing Functions Method, Stability Analysis by Describing Function Method. Lyapunov's Stability Analysis, Lyapunov's Stability Criterion, Direct Method of Lyapunov and the Linear Systems, Method of Construction of Lyapunov Functions for Nonlinear Systems.

Syllabus
ADVANCED CONTROL SYSTEM (MEET-102)

L:T:P:: 3:1:0   **Credits-4**

UNIT-IV   **(8 hours)**

OPTIMAL CONTROL Introduction to Optimal Control, Parameter Optimization: Servomechanism, Optimal Control Problem: Transfer Function and State Variable Approach, State Regulator Problem, Infinite Time Regulator Problem, Output Regulator and the Tracking Problem, Parameter Optimization: Regulators.

UNIT-V   **(8 hours)**

DIGITAL CONTROL SYSTEMS Introduction to Discrete Time Systems, Necessary for Digital Control System, Spectrum Analysis of Sampling Process, Signal Reconstruction, Difference Equations, Z transforms, and the Inverse Z transform, Pulse Transfer Function, Time Response of Sampled Data Systems, Stability using Jury Criterion, Bilinear Transformation**.**

REFERENCES:

1) Katsuhiko Ogata, Modern Control Engineering Prentice-Hall of India, New Delhi.
2) I. J. Nagarath and M. Gopal, Control system Engineering, New Age International (P) Ltd.
3) Katsuhiko Ogata, State Space Analysis of Control Systems, Prentice Hall Inc, New Jersey.
4) Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, 8th Edition, John Wiley & Sons.
5) Brain D., Anderson and J. B. Moore, Optimal Control, Prentice Hall.
6) Andrew P., Sage, Optimum Systems Control, Prentice Hall.
7) M. Gopal , Digital Control & State Variable Methods, TMH.
8) A. NagoorKani, Control System, RBA Publications

<div align="center">

Syllabus
Renewable Energy System (MPST111)

</div>

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of distributed generation and renewable energy sources , integrated operation of renewable energy sources.To comprehend the Impact of Distributed Generation on Power System. To familiarize with the Power Electronics Interface with the Grid and to analyze the issues of power quality disturbances.

Course Outcomes:

Students will be able to-
1. Appreciate the need for distributed generation and renewable energy sources.
2. Explain the concept of the integrated operation of renewable energy sources.
3. Describe the Power Electronics Interface with the Grid.
4. Analyze the issues of power quality disturbances.
5. Impact of Distributed Generation on Power System.

Syllabus:

UNIT-I   **(8 hours)**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-II   **(8 hours)**

Introduction to Distributed vs Central Station, Sources of Energy such as Micro-turbines,Internal Combustion Engines. Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, WaveEnergy, Geothermal Energy, Biomass and Fuel Cells.

UNIT-III   **(8 hours)**

Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Solar/Wind: Three phase AC voltage controllers. Power Electronic Interface with the Grid

UNIT-IV   **(8 hours)**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT). Impact of Distributed Generation on the Power System,Power Quality Disturbances

UNIT-V   **(8 hours)**

Stand alone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system Transmission System Operation, Economics of Distributed Generation, Case Studies

REFERENCES:

1. Ranjan Rakesh, Kothari   D. P, Singal K.C, "Renewable Energy Sources   and Emerging Technologies", 2nd Ed. Prentice Hall of India, 2011.
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System," July 2011,Wiley –IEEE Press.
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators." October 2007, Wiley-IEEE Press.
4. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010.
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Syllabus
POWER SYSTEM MODELING (MEET112)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of transmission line, load and reactive power compensator modeling. To comprehend the effect of steady state and dynamic analysis on simulation models. To understand the modeling of synchronous machine and analyze its performance. To develop excitation system components modeling and analyze their performance.

Course Outcomes:
The student will be able to:
1. Develop power system components modeling and analyze their performance
2. Develop modeling of synchronous machine and analyze its performance
3. Perform steady state and dynamic analysis on simulation models
4. Develop excitation system components modeling and analyze their performance.
5. Understand and transmission line, load and reactive power compensator modeling.

Syllabus:

UNIT-I   **(8 hours)**

Modeling of Power System Components
The need for modeling of power system, different areas of power system analysis. Models of non-electrical components like boiler, steam & hydro-turbine & governor system. Transformer modeling such as auto-transformer, tap-changing & phase shifting transformer.

UNIT-II   **(8 hours)**

Synchronous machine modeling
Model required for steady-state analysis. The development of model required for dynamic studies. The current & flux linkage models using Park's transformation leading to simulation as linear model.

UNIT-III   **(8 hours)**

Analysis of synchronous machine modeling
Synchronous machine connected to an infinite bus, its simulation for steady-state condition

UNIT-IV   **(8 hours)**

Excitation systems
Excitation control systems using dc generator exciter, alternator-rectifier, alternator SCR, and voltage regulators such as electro-mechanical and solid state. Modeling of excitation systems

Syllabus
POWER SYSTEM MODELING (MEET112)

L:T:P:: 3:0:0   **Credits-3**

UNIT-V   **(8 hours)**

Transmission line, SVC and load modeling
Transmission line modeling, Modeling of static V AR compensators, load modeling

REFERENCES:

1. P. Kundur, "Power System Stability and Control", McGraw-Hill, 1993.

2. R. Ramunujam, "Power System Dynamics Analysis and Simulation, PHI Learning Private Limited," New Delhi, 2009.

3. Electric Power Systems: B.M. Weddy and B.J. Cory, John Wiely and Sons, Fourth edition (2002).

4. Power System Analysis and Design : J. Duncan Glover, Mulukutla S. Sarma, ThomsonBrooks/cole/ Third Edition (2003).

Syllabus

APPLICATION OF POWER ELECTRONICS IN POWER SYSTEMS (MEET113)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of FACTs and identify FACTS devices. To comprehend the effect of different thyristors and self-commutating device based compensator. To understand the Model and analyse the FACT controllers. To understand the active filtering techniques in mitigation of harmonic distortion.

Course Outcomes:
Upon successful completion of this course the student will be able to:
1. Explain the concept of FACTs and identify FACTS devices
2. Select proper compensator to solve the problems occurring power transmission
3. Control different thyristors and self-commutating device based compensator
4. Model and analyse the FACT controllers
5. Apply the active filtering techniques in mitigation of harmonic distortion.

Syllabus:

UNIT-I   **(8 hours)**

Review of semiconductor devices, Steady state and dynamic problems in AC systems, Power flow, transmission line model and loadability, Reactive power transmission and associated difficulties, Regulated shunt compensation, Models of OLTC and Phase shifting transformer, Instantaneous reactive Power theory.

UNIT-II   **(8 hours)**

Flexible AC transmission systems (FACTS): Basic realities & roles, Reactive power control, Brief description and definition of FACT's controllers, Shunt compensators, Configuration and operating characteristics of TCR, FC-TCR, TSC,

UNIT-III   **(8 hours)**

Description of static VAR compensators (SVC), Thyristor Controlled series compensators (TCSC), Basic principleand different mode of operation, Analysis, Variable-reactance model and transient stability model of TCSC.

UNIT-IV (8 hours)

Static phase shifters (SPS), Static compensator (STATCOM), Static synchronous series compensator (SSSC) and Unified powerflow controller (UPFC), IPFC, Impact of Distributed Generation on the Power System, Power Quality Disturbances.

UNIT-V (8 hours)

Harmonics, harmonics creating loads, modelling, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, Active filters, passive filters. Filtering characteristic harmonics.

REFERENCES:

1. Understanding of FACTs., Hingorani, N. G.; IEEE Press 1996.
2. Electric Power Quality, Heydt G.T.; Stars in a Circle Publications , Indiana, 1991.
3. Static Reactive Power Compensation.; Miller T.J.E.; John Wiley & Sons, New York, 1982
4. Flexible AC Transmission System. (FACTs).; Yong Hua Song.; IEE 1999.
5. N. G. Hingorani and L. Gyugyi, "Understanding facts: Concepts and Technology of flexible AC transmission systems", Wiley Press 2000.

Syllabus
HYBRID ELECTRIC VEHICLES (MEET114)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic need and history behind electric vehicles, configurations of hybrid electric vehicles. To comprehend the electric Traction drive train mechanism and power flow. To understand the energy management strategies in a hybrid electric vehicle. To understand the electric motor required for HEV.

CourseOutcomes:
Upon successful completion of this course the student will be able to:
1. Appreciate the need and history behind electric vehicles.
2. Present the configurations of hybrid electric vehicles (HEV).
3. Explain the electric Traction drive train mechanism and power flow.
4. Select and employ the electric motor required for HEV.
5. Describe the energy management strategies in a hybrid electric vehicle.

Syllabus:

UNIT-I   **(8 hours)**

History of hybrid and electric vehicles, SocialandenvironmentalimportanceofhybridandelectricvehiclesImpactof modern drive-trains on energy supplies, Basics vehicle performance,   vehicle, power source characterization Transmission characteristics, Mathematical models to describe vehicle performance

UNIT-II   **(8 hours)**

The basic concept of hybrid traction, Introduction   to   various   hybrid   drive-train   topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III   **(8 hours)**

Introduction to electric components used in hybrid and electric
Vehicles, Configuration, and control of DC Motor drives configuration and control of Introduction Motor drives, controlof Permanent Magnet Motor drives configuration, and control of Switch Reluctance Motor drives, drive system efficiency

UNIT-IV   **(8 hours)**

Matching   the   electric   machine   and   the   internal   combustion engine (ICE), Sizing the propulsion motor, sizing he power electronics, Selecting the energy storage technology,Communications, supporting subsystems Introduction to energy management and the strategies used in hybrid and electric vehicle

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus
HYBRID ELECTRIC VEHICLES(MEET114)

L:T:P:: 3:0:0   **Credits-3**

UNIT-V   **(8 hours)**

Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

4. CRC Press Freebook, "Hybrid and Electric Vehicles," CRC Press (Taylor and Francis group).

5. Wei Liu, "Introduction to Hybrid Vehicle System Modeling and Control," Wiley Publications.

6. A. K. babu, "Electric and Hybrid Vehicles," Khanna Publishing.

7. K. T. Chau, "Electric Vehicles, Machines and Drives: Design, Analysis and Application," IEEE Press

Syllabus
POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS (MEET 121)

L:T:P:: 3:0:0 **Credits-3**

Course Objectives:

To explore the basic understanding of stand alone and grid connected renewable energy systems. To comprehend the power converters for renewable energy applications. To understand the Model and analyse the FACT controllers .To understand the power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems. To understand how to develop MPPT algorithms.

COURSE OUTCOMES:
Upon successful completion of this course the student will be able to:
1) Describe and analyse the stand alone and grid connected renewable energy systems.
2) Design power converters for renewable energy applications.
3) Analyze the various operating modes of wind electrical generators and solar energy systems.
4) Design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
5) Develop maximum power point tracking algorithms.

Syllabus:

UNIT-I **(8 hours)**

INTRODUCTION Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems: operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.

UNIT-II **(8 hours)**

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT-III **(8 hours)**

POWER CONVERTERS: Block diagram of solar photo voltaic system, line commutated converters, (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT-IV **(8 hours)**

ANALYSIS OF WIND AND PV SYSTEMS Standalone operation of fixed and variable speed wind energy conversion systems and solar system, Grid connection Issues, Grid integrated PMSG and SCIG Based WECS, Grid Integrated solar system

Syllabus
POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS (MEET 121)

L:T:P:: 3:0:0 **Credits-3**

UNIT-V **(8 hours)**

HYBRID RENEWABLE ENERGY SYSTEMS Need for Hybrid Systems- Range and type of Hybrid systems-Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).

REFERENCES:

1) S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009

2) Rashid M. H. "Power Electronics Hand book", Academic press, 2001.

3) Rai G.D., "Non Conventional Energy Sources", Khanna publishes, 1993.

4) Rai. G.D.," Solar Energy Utilization", Khanna publishes, 1993.

Syllabus
HVDC TRANSMISSION SYSTEM (MEET122)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission. To Analyze the different harmonics generated by the converters and their variation with the change in firing angles. To understand the existing HVDC systems along with MTDC systems and their controls.

Course Outcomes:
At the end of the course, a student will be able to:
1. Select the HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.
2. Formulate and solve mathematical problems related to rectifier and inverter control methods.
3. Analyze the different harmonics generated by the converters and their variation with the change in firing angles.
4. Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters.
5. Review the existing HVDC systems along with MTDC systems and their controls

Syllabus:

UNIT-I   **(8 hours)**

Introduction: Introduction of DC power transmission technology, comparison of AC and DC transmission, limitation of HVDC transmission, reliability of HVDC systems, application of DC transmission, description of DC transmission system, planning for HVDC transmission, modern trends in DC transmission

UNIT-II   **(8 hours)**

Analysis of HDVC converters: Choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, Characteristics of a twelve pulse converter, detailed analysis of converters.

UNIT-III   **(8 hours)**

Control of HVDC converter and systems: Necessity of control of a DC link, rectifier control, compounding of rectifiers, power reversal of DC link, voltage dependent current order limit(VDCOL), inverter extinction angle control, pulse phase control, starting and stopping of DC link, constant power control, control scheme of HVDC converters.

Syllabus
HVDC TRANSMISSION SYSTEM (MEET122)

L:T:P:: 3:0:0   **Credits-3**

UNIT-IV   **(8 hours)**

Harmonics and filters: Generation of harmonics by converters, characteristics of harmonics on DC side, characteristics of current harmonics, characteristic variation of harmonic currents with variation of firing angle and overlap angle, effect of control mode on harmonics, non-characteristic harmonic. Harmonic modeland equivalent circuit, use of filter, filter configuration, filters with voltage source converter HDVC schemes

UNIT-V   **(8 hours)**

Multi-terminal HVDC systems: Types of multi-terminal (MTDC) systems, parallel operation aspect of MTDC. Control of power in MTDC. Multilevel DC systems. Power upgrading and conversion of AC lines into DC lines, Parallel AC/DC systems. HYBRID

REFERENCES:

1. HVDC Transmission, S. Kamakshaiah & V. Kamaraju, Tata McGraw Hill education

2. HVDC Power transmission system, K.R. Padiyar, Wiley Eastern Limited

3. High Voltage Direct Current Transmission, J. Arrillaga, Peter Pregrinu

4. Power System Stability and Control by Prabha Kundur, McGraw hill

5. Power System Analysis: Operation and Control, Abhijit Chakrabarti and Sunita Halder, PHI Learning Pvt.

Syllabus

MODERN OPTIMIZATION TECHNIQUES (MEET123)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of constrained and unconstrained optimization techniques . To Solve complex problem using the Evolutionary algorithms. To understand the multi-objective function approach for optimization . To understand the transportation and assignment problems .

Course Outcomes:

After the completion of the course the student will be able to
1) Explain the difference between constrained and unconstrained optimization techniques.
2) Solve complex problem using the Evolutionary algorithms.
3) Apply PSO technique.
4) Solve constrained problems like the transportation and assignment problems.
5) Use multi-objective function approach for optimization.

Syllabus:

UNIT-I   (8 hours)

FUNDAMENTALS OF OPTIMIZATION Definition-Classification of optimization problems, Unconstrained and Constrained optimization, Optimality conditions, Classical Optimization techniques (Linear and non linear programming, Quadratic programming, Mixed integer programming)-Intelligent Search methods (Optimization neural network, Evolutionary algorithms, Tabu search, PSO, Application of fuzzy set theory).

UNIT-II   (8 hours)

EVOLUTIONARY COMPUTATION TECHNIQUES Evolution in nature, Fundamentals of Evolutionary algorithms, Working Principles of Genetic Algorithm, Evolutionary Strategy and Evolutionary Programming-Genetic Operators-Selection, Crossover and Mutation-Issues in GA implementation, GAbased Economic Dispatch solution, Fuzzy Economic Dispatch including losses, Tabu search algorithm for unit commitment problem, GA for unit commitment, GA based Optimal power flow, GA based state estimation.

UNIT-III   (8 hours)

PARTICLE SWARM OPTIMIZATION Fundamental principle, Velocity Updating, Advanced operators, Parameter selection, Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO), Binary, discrete and combinatorial PSO Implementation issues, Convergence issues, PSO based applications to Drive Control

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus

MODERN OPTIMIZATION TECHNIQUES (MEET123)

L:T:P:: 3:0:0   **Credits-3**

UNIT-IV   **(8 hours)**

ADVANCED OPTIMIZATION METHODS Simulated annealing algorithm, Tabu search algorithm, SA and TS for unit commitment, Ant colony optimization, Bacteria Foraging optimization.

UNIT-V   **(8 hours)**

MULTI OBJECTIVE OPTIMIZATION Concept of pareto optimality, Conventional approaches for MOOP, Multi objective GA, Fitness assignment-Sharing function, MOGA-Multi-objective PSO and its application in Drive Control.

REFERENCES:

1) D. P. Kothari and J. S. Dhillon, "Power System Optimization", 2ndEdition, PHI learning private limited, 2010.

2) Kalyanmoy Deb, "Multi objective optimization using Evolutionary Algorithms", John Wiley and Sons, 2008.

3) Kalyanmoy Deb, "Optimization for Engineering Design", Prentice hall of India first edition, 1988.

4Carlos A. Coello Coello, Gary B. Lamont, David A. Van Veldhuizen, "Evolutionary Algorithms for solving Multi Objective Problems", 2ndEdition, Springer, 2007.

5) Kwang Y. Lee, Mohammed A. ElSharkawi, "Modern heuristic optimization techniques", John Wiley and Sons, 2008.

Syllabus

ADVANCED DIGITAL SIGNAL PROCESSING (MEET124)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of the time domain and frequency domain representations as well analysis ofdiscrete time signals and systems . To Study the design techniques for IIR and FIR filters and their realization structures. To understand the finite word length effects in implementation of digital filters.To understand the Design of optimum FIR and IIR filters.

Course Outcomes:
Students will be able to-

1. Knowledge about the time domain and frequency domain representations as well analysis ofdiscrete time signals and systems.
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum ofstationary random signals.
5. Design of optimum FIR and IIR filters.

Syllabus:

UNIT-I   **(8 hours)**

Discrete time signals, Linear shift invariant systems- Stability and causality
Sampling of continuous time signals- Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier Transform ,Z transform-Properties of different transforms

UNIT-II   **(8 hours)**

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters Impulse invariance method, Bilinear transformation method

UNIT-III   **(8 hours)**

FIR filter design using window functions, Comparison of IIR and FIR digital filters Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors ,Coefficient quantization effects in IIR and FIR filters

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus

ADVANCED DIGITAL SIGNAL PROCESSING (MEET124)

L:T:P:: 3:0:0   **Credits-3**

UNIT-IV   **(8 hours)**

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling Overflow of oscillations and zero Input limit cycles in IIR filter, Linear Signal Models

UNIT-V   **(8 hours)**

Single pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals. Estimation of power spectrum of stationary random signals, Optimum linear filters, Optimum signal estimation Mean square error estimation, Optimum FIR and IIR Filters

REFERENCES:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ",TataMcGrow-Hill Edition1998

2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus

DIGITAL PROTECTION OF POWER SYSTEM(MEET201)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of digital protection with the usefulness of mathematics in digital protection. To analyze and implement the Interpolation, Numerical differentiation, Curve fitting, Least-squares, Fourier, and Walsh function-based techniques in digital protection. To understand the Signal conditioning and Conversion subsystems of the digital relay to work as a Units consisting of hardware and software. To analyze and implement the Sinusoidal, Fourier, and Walsh-based algorithms in digital protection.

Course Outcomes:

Students will be able to-
1. Analyze the major advantages of digital protection with the usefulness of mathematics in digital protection.
2. Analyze and implement the Interpolation, Numerical differentiation, Curve fitting, Least-squares, Fourier, and Walsh function-based techniques in digital protection.
3. Analyze the Signal conditioning and Conversion subsystems of the digital relay to work as a Units consisting of hardware and software.
4. Analyze and implement the Sinusoidal, Fourier, and Walsh-based algorithms in digital protection.
Analyze and implement the Differential equation-based algorithms

Syllabus

UNIT-I   **(8 hours)**

Evolution of digital relays from electro mechanical relays, Performance and operational characteristics of digital protection**.**

UNIT-II   **(8 hours)**

Mathematical back ground to protection algorithms, Finite difference techniques**.**

UNIT-III   **(8 hours)**

Interpolation formulae, Forward, backwardandcentraldifferenceinterpolationNumericaldifferentiation Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis

Syllabus

DIGITAL PROTECTION OF POWER SYSTEM(MEET201)

L:T:P:: 3:1:0   **Credits-4**

UNIT-IV   **(8 hours)**

Basic elements of digital protection , Signal conditioning :transducers, surge protection, analog filtering, analog multiplexers, Conversion sub system: the sampling theorem, signal aliasing, Error,sampleandholdcircuits,multiplexers,analogtodigitalconversion, Digital filtering concepts, The digital relay as a Units consisting of hard ware and software

UNIT-V   **(8 hours)**

Sinusoidal wave based algorithms, Sample and first derivative (MannandMorrison) algorithm. Fourier and Walsh based algorithms, Least Squares based algorithms. Differential equation based algorithms. Traveling Wave based Techniques. Digital Differential Protection of Transformers. Digital Line Differential Protection. Recent Advances in Digital Protection of Power Systems.

REFERENCES:

1.   A.G.Phadke and J.S.Thorp,"ComputerRelayingforPowerSystems",Wiley/ResearchstudiesPress, 2009.
2.   A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEEPress,1999
     .
3.   Gerhard Zeigler,"NumericalDistanceProtection",SiemensPublicisCorporatePublishing,2006

4.   S.R. Bhide, "DigitalPowerSystemProtection"PHILearningPvt.Ltd.2014.

Syllabus

SEMI CONDUCTOR CONTROLLED DRIVES (MEET202)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of theclosed loop controlled DC drives. To Describe the modern trends of DC Dives.To understand the vector control method for controlling the Induction and synchronous motor.

Course Outcomes:

1) Develop the closed loop controlled DC drives.

2) Describe the modern trends of DC Dives.

3) Use vector control method of speed control of Induction motor.

4)Apply the various speed control methods for controlling the speed of synchronous motor.

5) Use vector control method for controlling the Induction and synchronous motor.

Syllabus

UNIT-I   **(8 hours)**

D.C. DRIVES Introduction, principle of DC motor speed control, phase controlled converters, steady state analysis of three phase supplied converter controlled DC motor Drive, Introduction, Principle of operation of the chopper, Chopper controlled drives, Duty-ratio control, current-limit control, steady state analysis, four quadrant chopper circuit, chopper for inversion, chopper with other power devices, mode of chopper, input to the chopper, steady state analysis of chopper controlled DC Drives, pulsating torques.

UNIT-II   **(8 hours)**

CLOSED-LOOP CONTROL OF DRIVES Introduction- Basic features of an Electric Drive- Block diagram representation of Drive systems, signal flow graph representation of the systems, Transfer functions, transient response of closed loop drives systems. Speed control of a separately excited DC drive with inner current loop and outer speed loop

UNIT-III   **(8 hours)**

SPEED CONTROL OF INDUCTION MOTOR Speed control methods of Induction motor, Variable voltage operation, Variable frequency operation, Constant flux operation, Constant Torque and Constant power operation, V/f control with slip compensation scheme Closed loop control schemes, dynamic and regenerative braking, speed reversal. Torque slip characteristics- speed control through slip, rotor resistance control-chopper controlled resistance equivalent resistance combined stator voltage control and rotor

Syllabus

SEMI CONDUCTOR CONTROLLED DRIVES (MEET202)

L:T:P:: 3:1:0   **Credits-4**

resistance control- design solutions. Closed loop control scheme. Slip power recovery, torque slip characteristics, power factor considerations.

UNIT-IV   **(8 hours)**

VECTOR CONTROL OF INDUCTION MOTOR DRIVE Review of dq0 model of 3-Ph IM, Principle of vector control of IM, Direct vector control, Indirect vector control with feedback, Indirect vector control with feed-forward, Indirect vector control in various frames of reference, Decoupling of vector control with feed forward compensation, Direct Torque Control of IM

UNIT-V   **(8 hours)**

SPEED CONTROL OF SYNCHRONOUS MOTOR DRIVES (09Hours) Three phase synchronous machine and analysis of steady state operation, voltage and torque equations in machine variables and rotor reference frame variables (Park's equations), analysis of dynamic performance for load torque variations. Types of PM Synchronous motors, Torque developed by PMSM, Model of PMSM, vector control for PMSM

REFERENCES:

1) G.K.Dubey, Power Semi conductor controlled Drives, New Age Int. Pub.

2) S.B.Dewan, G.R.Slemon&A.Stranghan, Power Semi conductor controlled Drives, Johnwiley Pub.

3) Shepherd Hullay&Liag, Power Electronics & Motor Control: Cambridge Univ. Press

4) R.Krishnan, Electric Motor drives – Modelling, Analysis & Control:, PHI India,Ltd.

5) VedamSubramanyam, Thyristor Control of Electric Drives

6) Vector Control of AC Drives, I. Boldea and S. A. Nasar, CRC Press LLC, 1992.

Syllabus
RESTRUCTURED POWER SYSTEMS(MEET231)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of various types of regulations in power systems. To Identify the need of regulation and deregulation. To describe the Technical and Non-technical issues in Deregulated Power Industry. To understand different market mechanisms and summarize the role of various entities in the market.

Course Out comes:
Students will be able to-

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classifydifferentmarketmechanismsandsummarizetheroleofvariousentitiesinthemarket.

Syllabus:

UNIT-I   **(8 hours)**

Introduction to restructuring of power industry:
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Load elasticity, Social welfare maximization, vertically integrated systems, deregulated power systems across the world.

UNIT-II   **(8 hours)**

Fundamentals of Economics:
Introduction, Consumer behavior, Supplier behavior, Market equilibrium, Relationship between short-run and long-run average costs, Perfectly competitive market, Market models based on contractual arrangements, Comparison of various market models

UNIT-III   **(8 hours)**

Transmission Congestion Management:
Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based methods, Nodal pricing, Inter-zonal Intra-zonal congestion management,
Price area congestion management, Capacity alleviation Method.

Syllabus

RESTRUCTURED POWER SYSTEMS(MEET231)

UNIT-IV   **(8 hours)**

Ancillary services, Types, Load-generation balancing related services, Voltage control and reactive power support services, Black start capability service, Co-optimization of energy and reserve services

UNIT-V   **(8 hours)**

Market power and generators bidding:
Attributes of a perfectly competitive market, Imperfect competition, Market power, Optimal bidding, Risk assessment Hedging, Transmission pricing, Tracing of power, IT applications in restructured markets, Working of restructured power systems.

REFERENCES:

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel DekkerPub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Bollen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading
    and volatility", Marcel Dekker.
5. Fundamentals of Power System economics by Daniel Kirschen and Goran Strbac, John Wiley & Sons Ltd, 2004.
6. Operation of restructured power systems Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, Kluwer Academic Pub., 2001

Syllabus

ENERGY MANAGEMENT AND AUDITING (MEET232)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of present state of energy security and its importance. To describe the basic principles and methodologies adopted in energy audit of utility . To describe the Audit energy in domestic and industrial units. To understand the energy performance evaluation of installations having motors.

COURSE OUTCOMES:

Upon successful completion of this course the student will be able to:
1) Identify and describe present state of energy security and its importance.

2) Identify and describe the basic principles and methodologies adopted in energy audit of utility.

3) Carryout the energy performance evaluation of installations having motors.

4) Analyze the data collected during performance evaluation and recommend energy saving measures

5) Audit energy in domestic and industrial units.

Syllabus:

UNIT-I   **(8 hours)**

BASIC PRINCIPLES OF ENERGY AUDIT Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit Need for energy management, energy basics, designing and starting an energy management program, energy audit process. Need for energy management, energy basics, designing and starting an energy management program, energy accounting, energy monitoring, targeting and reporting.

UNIT-II   **(8 hours)**

ENERGY COST AND LOAD MANAGEMENT Important concepts in an economic analysis, economic models, time value of money, utility rate structures, cost of electricity, loss evaluation. Load management: demand control techniques, utility monitoring and control system-HVAC and energy management, economic justification.

UNIT-III   **(8 hours)**

ENERGY EFFICIENT MOTORS Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics, variable speed, variable duty cycle systems, RMS hp voltage variation,

Syllabus

ENERGY MANAGEMENT AND AUDITING (MEET232)

L:T:P:: 3:1:0   **Credits-4**

voltage unbalance, over motoring, motor energy audit applications to Systems and equipment such as: electric motors, transformers and reactors, capacitors and synchronous machines.

UNIT-IV   **(8 hours)**

METERING FOR ENERGY MANAGEMENT Relationships between parameters, Units of measure, typical cost factors, utility meters, timing of meter disc for kilowatt measurement, demand meters, paralleling of current transformers, instrument transformer burdens, multitasking solid-state meters, metering location vs. requirements, metering techniques and practical examples.

UNIT-V   **(8 hours)**

LIGHTING SYSTEMS AND COGENERATION Concept of lighting systems, the task and the working space, light sources, ballasts –luminaries, lighting controls, optimizing lighting energy, power factor and effect of harmonics on power quality, cost analysis techniques, lighting and energy standards. Cogeneration: forms of cogeneration, feasibility of cogeneration, electrical interconnection. Economics Analysis-Depreciation Methods

REFERENCES:

1) Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990.

2) Reay D.A., "Industrial Energy Conservation", first edition, Pergamon Press, 1977.

3) IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

4) Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.

5) Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", Fifth Edition, The Fairmont Press, Inc., 2006

Syllabus

DYNAMICS OF ELECTRICAL MACHINES (MEET233)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of electrodynamic equations of all electric machines and analyze the performance characteristics. To describe the basic principles of transformations for the dynamic analysis of machines. To describe the stability of the machines under small signal andtransient conditions.

Course Outcomes:
Students will be able to-
1. Formulation of electrodynamic equations of all electric machines and analyze theperformance characteristics.
2. Knowledge of transformations for the dynamic analysis of machines.
3. Knowledge of determination of stability of the machines under small signal andtransient conditions.
4. Study about synchronous machine.
5. Determine the stability of machine.

Syllabus:

UNIT-I   **(8 hours)**

Stability, Primitive four-Winding Commutator MachineCommutator Primitive Machine, Complete Voltage Equation of Primitive four-Winding Commutator Machine

UNIT-II   **(8 hours)**

Torque Equation Analysis of Simple DC Machines using the PrimitiveMachine Equations, Three Phase Induction Motor.Transformed Equations, Different Reference Frames for Induction Motor Analysis Transfer Function Formulation

UNIT-III   **(8 hours)**

Three Phase Salient Pole Synchronous Machine, Parks Transformation, Steady State Analysis

Syllabus

DYNAMICS OF ELECTRICAL MACHINES (MEET233)

L:T:P:: 3:1:0   **Credits-4**

UNIT-IV   **(8 hours)**

Large Signal Transient, Small Oscillation Equations in State Variable formDynamical Analysis of Interconnected Machines

UNIT-V   **(8 hours)**

  Large Signal Transient Analysis using Transformed Equations ,DC Generator /DC Motor System Alternator /Synchronous Motor System

REFERENCES:

1. D. P. Sengupta & J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980

2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education.,2001

3. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company,1987

4. I. Boldia & S.A. Nasar,,"Electrical Machine Dynamics", The Macmillan Press Ltd. 1992

5. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967

Syllabus

POWER APPARATUS DESIGN (MEET234)

L:T:P:: 3:1:0   **Credits-4**

Course Objectives:

To explore the basic understanding of rotating machine employed in Power Systems . To describe the basic principles of electromagnetic energy conversion, sizing and rating of machines. To describe the Model rotating machines under transient conditions.

Course Outcomes:

Students will be able to-

1. Analyze of rotating machine employed in Power Systems.
2. Explain electromagnetic energy conversion.
3. Select sizing and rating of machines.
4. Model rotating machines under transient conditions.
5. Design rotating electrical machines.

Syllabus:

UNIT-I   **(8 hours)**

Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling.

UNIT-II   **(8 hours)**

Specific loadings, choice of magnetic and electric loadings Real apparent flux -densities, temperature rise calculation Separation of main dimension for DC machines Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating.

UNIT-III   **(8 hours)**

General considerations, output equation, density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation Forces winding during short circuit.

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus

POWER APPARATUS DESIGN (MEET234)

L:T:P:: 3:1:0   **Credits-4**

UNIT-IV   **(8 hours)**

General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor Elimination of harmonic torques

UNIT-V   **(8 hours)**

Design of stator and rotor winding, slot leakage flux ,Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data, Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energyefficient machines.

REFERENCES:

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.

2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman

3. Sawhney A.K, "A course in Electrical Machine Design", Dhanpat Rai& Sons, 5th Edition.

Syllabus

ADVANCED MICRO-CONTROLLER BASED SYSTEMS (MEET241)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To Describe the architecture of advanced microcontrollers. To employ processor for these controllers
To understand the program a processor in assembly language for application system. To understand the DSP and
FPGA for control applications.

Course Outcomes:
Students will be able to-
1. Describe the architecture of advanced microcontrollers
2. Employ processor for these controllers
3. Program a processor in assembly language for application system
4. Configure different peripherals in a digital system
Explain DSP and FPGA for control applications

Syllabus

UNIT-I   **(8 hours)**

Basic Computer Organization with examples of 8086, 80X86, 8051 etc. Accumulator based Processes-
Architecture, Memory Organization-I/O Organization

UNIT-II   **(8 hours)**

Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication
Timers, Interrupts, Programming

UNIT-III   **(8 hours)**

Intel 8051 – Assembly language programming Addressing-Operations, Stack & Subroutines Interrupts-
DMA

UNIT-IV   **(8 hours)**

PIC 16F877- Architecture Programming Interfacing Memory/ I/O Devices, Serial I/O and data
communication

Syllabus
ADVANCED MICRO-CONTROLLER BASED SYSTEMS (MEET241)

L:T:P:: 3:0:0   **Credits-3**

UNIT-V   **(8 hours)**

 Digital Signal Processor (DSP)Architecture – Programming Introduction to FPGA
Microcontroller development for motor control applications, Stepper motor control using micro controller

REFERENCES:

1. John. F. Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons1981

2. Ramesh S. Gaonker: "Microprocessor Architecture, Programming and Applications with the8085",Penram International Publishing (India), 1994

3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005

4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004

5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005

6. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18FSeries", Elsevier, 2008

7. Microchip datasheets for PIC16F877

SCADA SYSTEM AND APPLICATIONS (MEET242)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of Supervisory Control Systems (SCADA) as well as their typical applications. To understand about the SCADA architecture and the various advantages and disadvantages.To learn about SCADA system components: remote terminal Units, PLCs, intelligent electronic devices, HMI systems, and SCADA servers. Learn and understand SCADA applications in the transmission and distributionsector, industries etc.

Course Outcomes:
Students will be able to-
1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as theirtypical applications.
2. Acquire knowledge about SCADA architecture and the various advantages and disadvantagesof each system.
3. Knowledge about single unified standard architecture IEC 61850.
4. To learn about SCADA system components: remote terminal Units, PLCs,intelligent electronic devices,HMI systems, and SCADA servers.
5. Learn and understand SCADA applications in the transmission and distributionsector, industries etc.

Syllabus

UNIT-I   **(8 hours)**

Introduction to SCADA:
Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, Benefits.

UNIT-II   **(8 hours)**

SCADA System Components:
Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Programmable Logic Controller (PLC), Intelligent Electronic Devices (IED),

UNIT-III   **(8 hours)**

SCADA System Components:
SCADA Server, SCADA/HMI Systems, SCADA Control systems and Control panels, Communication Network, Monitoring and supervisory functions,

Syllabus

SCADA SYSTEM AND APPLICATIONS (MPST242)

L:T:P:: 3:0:0   **Credits-3**

UNIT-IV   **(8 hours)**

Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC

UNIT-V   **(8 hours)**

SCADA Applications in Power System:
Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning. SCADA Design case study.

REFERENCES:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of AmericaPublications, USA, 2004

2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004

3. William T. Shaw, "Cybersecurity for SCADA systems", Penn Well Books, 2006

4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003

5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power",Penn Well 1999

Syllabus

POWER QUALITY (MEET243)

L:T:P:: 3:0:0 **Credits-3**

Course Objectives:

To explore the basic understanding of power quality issues to be addressed and recommended practices . To understand about the Model network components . To learn about series and shunt active power filtering techniques .To study the reactive power control and eliminate undesired harmonics.

Course Outcomes:

Students will be able to-

1.   Explain the different power quality issues to be addressed and recommended practices

2.   Analyze the effect of harmonics

3.   Model network components

4.   Compensate for reactive power control and eliminate undesired harmonics

5.   Apply series and shunt active power filtering techniques

Syllabus

UNIT-I **(8 hours)**

Introduction-power quality-voltage quality-overview of power quality phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C, message weights-flicker factor transient phenomena-occurrence of power quality problems, power acceptability curves-IEEE guides, standards and recommended practices

UNIT-II **(8 hours)**

Harmonics-individual and total harmonic distortion RMS value of a harmonic waveform- Triplex harmonics-important harmonic introducing devices-SMPS- Three phase power converters-arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads

UNIT-III **(8 hours)**

Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems Shunt capacitors-transformers-electric machines-ground systems loads that cause power quality problems, power quality problems created by drives and its impact on drive

Syllabus

POWER QUALITY (MEET243)

L:T:P:: 3:0:0   **Credits-3**

UNIT-IV   (8 hours)

Power factor improvement- Passive Compensation Passive Filtering, Harmonic Resonance, Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC, Based on Bilateral Single Phase and Three Phase Converter

UNIT-V   (8 hours)

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection, Filter for single phase, d-q domain control of three phase shunt active filters, uninterrupted   power supplies, constant voltage Transformers, series active power filtering techniques for harmonic cancellation and isolation. Dynamic Voltage Restorers for sag, swell and flicker problems. Grounding and wiring introduction. NEC grounding requirements

REFERENCES:

1.   G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007

2.   Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000

3.   J. Arrillaga, "Power System Quality Assessment", John wiley, 2000

4.   J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,"Power system Harmonic Analysis", Wiley, 1997

5.   H. W. Beaty, Mark F. McGranaghan, Roger C Dugan, "Electrical Power Systems Quality" McGraw-Hill

ARTIFICIAL INTELLIGENCE TECHNIQUES (MEET244)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

To explore the basic understanding of ANN Artificial Neural Networks , its use, control and design application. To Identify the fuzzy and neural network. To learn about series and shunt active power filtering techniques .To study the Genetic algorithm and evolutionary algorithms .

Course Outcomes:
Students will be able to-
1. Explain and apply ANN Artificial Neural Networks
2. Explain and apply fuzzy logic
3. Use Fuzzy logic in control and design application
4. Identify of fuzzy and neural network
5. Explain and apply Genetic algorithm and evolutionary algorithms

Syllabus

UNIT-I   **(8 hours)**

Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward Neural Networks, LMS and Back Propagation Algorithm, Backpropagation Learning, Variation of Standard Back Propagation Neural Network, Feedback networks and Radial Basis Function Networks

UNIT-II   **(8 hours)**

Fuzzy Logic, Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Knowledge Representation and Inference Mechanism, Minmax Composition, Defuzzification Method, Fuzzy logic in control and design application

UNIT-III   **(8 hours)**

Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA. System Identification using Fuzzy and Neural Network

Syllabus

ARTIFICIAL INTELLIGENCE TECHNIQUES (MPST244)

L:T:P:: 3:0:0   **Credits-3**

UNIT-IV   **(8 hours)**
Genetic algorithm, History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization. Introduction to evolutionary program, Applications.

UNIT-V   **(8 hours)**
Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

REFERENCES:

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 Company

Syllabus

ADVANCED POWER ELECTRONICS LAB (MEEP101)

L:T:P:: 0:0:3   **Credits-01**

Course Objectives:

To introduce the hands-on descriptions of various power semiconductor devices, converters, inverter etc. with the help of related instruments and devices.

Course Outcomes:
1. Analyse the behaviour of power semiconductor devices operated as power switches.
2. Analyse operation of DC-DC power converters
3. Select inverter for different application
4. Understand the advance power conversion techniques
5. Understand different tools like MATLAB, PSPICE etc..

Syllabus:

1. Experimental study for characteristics of DC-DC Buck converter.

2. Experimental study for characteristics of the DC-DC Boost converter.

3. Experimental study for characteristics of DC-DC Buck-Boost converter.

4. Experimental study for characteristics of single phase fully controlled Full Bridge converter.

5. Experimental study for characteristics of three-phase fully controlled Full Bridge converter.

6. Experimental study for characteristics of three-phase semi-controlled Full Bridge converter

7. PSPICE & MATLAB Simulation of Three phase full converter using RL and E loads.

8. PSPICE & MATLAB Simulation of Single-phase AC Voltage controller using RL load.

9. PSPICE & MATLAB Simulation of Three-phase inverter with PWM controller.

10. PSPICE & MATLAB Simulation of resonant pulse commutation circuit.

11. PSPICE & MATLAB Simulation of impulse commutation circuit.

Syllabus

ADVANCED CONTROL SYSTEM LAB(MEEP102)

L:T:P:: 0:0:3   **Credits-01**

Course Objectives:

To introduce the hands-on descriptions of various power semiconductor devices, converters, inverter etc. with the help of related instruments and devices.

Course Outcomes:
1. Analyze dynamics of a linear system by State Space Representation.
2. Determine the stability of a linear system using pole-placement technique and Design state observers.
3. Analyze basics of Non-linear control system.
4. Formulate and solve deterministic optimal control problems in terms of performance indices.
5. Realize the structure of a discrete time system and model through MATLAB.

Syllabus:

1   Design of lead-lag compensator for the given system.

2   Control of Linear and circular inverted Pendulum

3   Control of higher degree of freedom of robotic manipulator

4   Closed Loop Speed control of PMDC motor

5   Study of Water level control using Industrial PLC

6   Design of H infinity controller for any nonlinear system using MATLAB

7   Analyze the plots of time and frequency responses of MIMO systems using MATLAB.

8   Fuzzy Logic Controller design for a Pendulum on a cart using MATLAB.

Syllabus

ADVANCED POWER SYSTEM PROTECTION LAB (MEEP201)

L:T:P:: 0:0:3   **Credits-01**

Course Objectives:

To introduce the hands-on descriptions of various digital protection device , different protection relays etc. with the help of related instruments and devices.

Course Outcomes:
1. Analyze the major advantages of digital protection with the usefulness of mathematics in digital protection.
2. Analyze and implement the Interpolation, Numerical differentiation, Curve fitting, Least-squares, Fourier, and Walsh function-based techniques in digital protection.
3. Analyze the Signal conditioning and Conversion subsystems of the digital relay to work as a Units consisting of hardware and software.
4. Analyze and implement the Sinusoidal, Fourier, and Walsh-based algorithms in digital protection.
5. Analyze and implement the Differential equation-based algorithms

Syllabus:

1. Introduction to Power System Protection

2. Impact of Induction Motor Starting on Power System

3. Modeling of Differential Relay using MATLAB

4. Radial Feeder Protection

5. Parallel Feeder Protection

6. Principle of Reverse Power Protection

7. Differential Protection of Transformer

8. To the study time vs. voltage characteristics of over-voltage induction relay

Syllabus

ELECTRIC DRIVES LAB (MEEP202)

L:T:P:: 0:0:3   **Credits-01**

Course Objectives:

To introduce the hands-on descriptions of various type of speed control of different motors i.e. induction, synchronous etc. with the help of related instruments and devices.

Course Outcomes:
1. Develop the closed loop controlled DC drives.
2. Describe the modern trends of DC Dives.
3. Use vector control method of speed control of Induction motor.
4. Apply the various speed control methods for controlling the speed of synchronous motor.
5. Use vector control method for controlling the Induction and synchronous motor.

Syllabus:

1. Semiconductor converter based scalar control of permanent magnet synchronous motor

2. Three-phase voltage source converter based vector Controlled induction motor drive

3. DC-DC converter (Buck/Boost) based DC motor drive control

4. Speed control of DC Motor fed from single-phase thyristor converter

5 . Speed control of induction Motor fed from three-phase multi-pulse converter

6. Three phase five-level PWM converter fed DC motor drive control

7. Three-phase voltage source converter based Direct Torque Controlled induction motor drive

8. Space Vector PWM controlled PMSM drive

Syllabus

MOET391: Industrial Internet of Things

Text Books

1.   Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, by Daniel Minoli, Bernd Scholz-Reiter, Florian, Willy Publication

2.   Digital Twin Technologies and Smart Cities by Farsi, M., Daneshkhah, A., Hosseinian-Far, A., Jahankhani, H., Springer International Publishing, 2020.

3.   Architecting the Internet of Things, by Michahelles, Springer, 2011

Reference Books

1.   The Internet of Things Connecting Objects to the Web" by Hakima Chaouchi, Willy Publications

2.   The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 2nd Edition, Willy Publications

3.   Inside the Internet of Things (IoT), Deloitte University Press

4.   Internet of Things-From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Serie

Five thoughts from the Father of the Internet of Things; by Phil Wainewright -Kevin Ashton

Course Outcomes

At the end of this course the student will be able to:

1.
׀ Understand the elements of IoT to build a total control plane in an Industrial application.׀

2. Apply M2M protocols for development of IoT Applications.

3. Learn and understand the concept of digitalization and data acquisition.

4. Build smart factory based on the concepts

5. Build Industrial Digital Twins.

Syllabus

MOET392: Neural Computing Systems and Applications

L T P :3 0 0   **Credit 3**

Unit 1: (8 Hours)
 Introduction: Basic Model of Neuron, Characteristics, Neural Computing Structure and Functioning of Biological Brain & Neuron, Concept of learning/training, biasing effects in ANNS, Artificial Neuron model, Basic Specifications of Brain. Optimization theory of linear and non-linear functions, Gradient methods of optimization.

Unit 2: (8 Hours)
 Learning Methods and Architectures: Delta-rule for training, LMS Algorithm, Limitations of Perceptron network, Introduction of Hebb's Law and Oja's Rule, Multilayer networks and Training using Back Propagation Algorithm.

Unit 3: (8 Hours)
 Introduction to Implementation of Neural Networks: Simulation & Hardware applications, Causal Neural Networks, Probabilistic Neural networks and Adaptive Non-linear Networks.

Unit 4: (8 Hours)

Hopfield Nets: Architecture, Energy functions, Growth Algorithms, Training Algorithms, Associative Memory and Short Term Memory, Genetic Algorithms.

Unit 5: (8 Hours)
Model of an Artificial Neuron: Transfer functions, ADALINES, MADALINES, Taxonomies used in ANNS. Logistic, TAN- Hyperbolic, Sigmoid, Threshold, Ramp, Exponential Functions used in Neural networks.

Text books:
1. Philip D. Wasserman, "Neural computing: Theory and Practice", Van Nostrand Reinhold edition 1989.
2. Clifford Lau, "Neural Networks: Theoretical foundations and Analysis, IEEE Press edition 1987.
3. G. Hadley, "Nonlinear and Dynamic Programming", Addison-Wesley edition 1970.

Reference books:
1. B. Yegnanarayana, "Artificial Neural Networks", Prentice-Hall of India edition 2009.
2. S. Haykin, "Neural Networks", Pearson Education edition 1999.
3. Li Ming Fu, "Neural Networks in Computer Intelligence", Tata McGraw Hill, India edition 2003.

COURSE OUTCOMES: After completing the course, student will able to:

1. Define and illustrate the basic model of neuron, its structure, characteristic and functions.
2. Show the skills to develop different algorithms applied in neural computing.
3. Demonstrate and analyze rules used in neural computing applications.
4. Explain model development of artificial neuron based neural computing.
5. Basis of implementation of neural network.

Syllabus

MOET393: Distributed Generation & Micro-Grids

L T P :3 0 0   **Credit 3**

Unit 1: Introduction (8 Hours)
Conventional power generation: advantages and disadvantages, Energy crises, Non - conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

Unit 2: Distributed Generations (DG) (8 Hours)

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

Unit 3: Impact Of Grid Integration (8 Hours)
Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

Unit 4: Basics of a MICROGRID (8 Hours)
Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.

Unit 5: Control and Operation of MICROGRID (8 Hours)
Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids

References:
1. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
2. Dorin Neacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, "Solar Photo Voltaics", PHI learning Pvt. Ltd., New Delhi, 2009
4. J.F. Manwell, J.G "Wind Energy Explained, Theory Design and Applications,". McGowan Wiley publication, 2nd Edition, 2009. 5. D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", John Wiley, New York, 1987.
6. John Twidell and Tony Weir, "Renewable Energy Resources", Taylor and Francis Publications, Second Edition, 2006.

COURSE OUTCOMES:
The student will have ability to
1. Describe the conventional power generation
2. Analyze the concept of distributed generation and installation
3. Design the grid integration system with conventional and non-conventional energy sources
4. Design the dc and ac micro grid
5. Analyze power quality issues and control operation of micro grid

Syllabus

MOET394: Fundamentals of Electric and Hybrid Vehicles

L T P : 3 0 0

Credit 3

Unit 1: Introduction to Electric Vehicles (8 Hours)

Evolution of Electric Vehicles, EV configurations - Fixed and variable gearing, Single and multiple-motor drives, In-wheel drives, Parameters of EV systems - Weight and size parameters, Force parameters, Energy parameters, Performance parameters

Unit 2: Hybrid EV systems (8 Hours)

HEV configurations - Series hybrid system, Parallel hybrid system, Series-parallel hybrid system, Complex hybrid system, Power flow control in Series hybrid system, Parallel hybrid system, Series-parallel hybrid system, Complex hybrid system, Case Study

Unit 3: Electric Propulsion Systems (8 Hours)

DC motor drives, Induction motor drives, Permanent-magnet motor drives, Switched reluctance motor drives and their role in EV and HEV systems. Performance study of electrical propulsion system with respect to application.

Unit 4: Energy Sources in EV and HEV systems (8 Hours)

Electrochemical Batteries – Terminology, Specific Energy, Specific Power, Energy Efficiency in Lead-Acid Batteries, Nicked based batteries, Lithium based batteries, Requirement of Ultra capacitors – Features, Principle of operation and Performance of UC, High Speed Flywheels – Operating Principles, Power capacity, Flywheel technologies, Hybrid Energy Storage Systems, Fuel Cell – Principle of Operation and Performance

Unit 5: EV Auxiliary Systems (8 Hours)

Battery characteristics and chargers, Battery indication, Temperature control unit, Power Steering Unit, Auxiliary Power Supply, Navigation system. Case Study: Public and Domestic Charging Infrastructure for Electric Vehicles.

References Books:
1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2 nd edition, 2009.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Syllabus

Course Outcomes:

After completion of this course, student will be able to

1. Differentiate among different types of Electric and Hybrid Vehicles and their configurations.
2. Decide suitable electric propulsion system for EV and HEV.
3. Determine the rating of energy source requirement of EV and HEV.
4. Analyse the role of auxiliaries in Electric and Hybrid Vehicles
5. Knowledge of charging Infrastructure for Electric Vehicles.

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

Syllabus

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

M.TECH. (Electrical Engineering) 2nd Year

(Effective from Session 2023-24)

Scheme of Examination for M.Tech. 2nd Year (Electrical Engineering) Programme

S. No.	Subject Codes	Subject Name	Periods			Sessional Exam			ESE		Subject Total	Credit
			L	T	P	CT	TA	Total	TE	PE		
1	AHT 310-AHT313/ MOET 395-MOET 398	Open Elective-2	3	0	0	30	20	50	100		150	3
2	MPSP 301	Seminar	0	0	4			100			100	2
3	MPSP 302	Project	0	0	10			100		150	250	5
4	MPSP303	Dissertation (Phase I)	0	0	12			300		-	300	6
		Total	**3**	**0**	**26**			**550**	**100**	**150**	**800**	**16**

Table title: **Semester III (effective from 2023-24)**

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week,

CT-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance,

PS-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks,PE- Practical External Examination Marks

Open Elective-2
AHT310: Business Analytics
AHT311: Industrial Safety
AHT312: Operations research
AHT313: Cost Management of Engineering Projects
MOET-395: Energy Auditing and Management
MOET396: Analysis And Design Of Artificial Neural Network
MOET397: Renewable Power Generation Technologies
MOET398: Power System Restructuring and Pricing

Scheme of Examination for M.Tech. 2nd Year (Electrical Engineering) Programme

S. No.	Subject Codes	Subject Name	Periods			Sessional Exam			ESE		Subject Total	Credit
Semester IV (effective from 2023-24)			L	T	P	CT	TA	Total	TE	PE		
1	MPSP 401	Dissertation (Phase II)	0	0	28			250		-	700	14
		Total	**0**	**2**	**28**			**250**		**450**	**700**	**14**

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

Scheme of Examination for B.Tech.-M.Tech. dual 1 Year M.Tech (Electrical Engineering) Programme

	Semester III (effective from 2023-24)											
S. No.	Subject Codes	Subject Name	Periods			Sessional Exam			ESE		Subject Total	Credit
			L	T	P	CT	TA	Total	TE	PE		
1	AHT-301*	Advanced Mathematics	3	1	0	30	20	50	100		150	4
2	MEET101*	Advanced Power Electronics	3	1	0	30	20	50	100		150	4
3	(MOET 391-MOET 394)*	Open Elective-1	3	0	0	30	20	50	100		150	3
4	AHT-302*	Research Methodology and IPR	2	0	0	30	20	50	50		100	2
5	MEEP 301	Seminar	0	0	4			100			100	2
6	MEEP 302	Project	0	0	10			100		150	250	5
7	MEEP303	Dissertation (Phase I)	0	0	12			300		-	300	6
		Total	11	2	26			700	350	150	1200	26

*Syllabus same as for Regular M.Tech. 1st Year course

Open Elective-1
MOET-391: Industrial Internet of Things
MOET392: Neural Computing Systems and Applications
MOET393: Distributed Generation & Micro-Grids
MOET394: Fundamentals of Electric and Hybrid Vehicles

Scheme of Examination for B.Tech.-M.Tech. dual 1Year M.Tech (Electrical Engineering) Programme

Semester IV (effective from 2023-24)													
S. No.	**Subject Codes**	**Subject Name**	**Periods**			**Sessional Exam**			**ESE**		**Subject Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**TE**	**PE**		
1	MEET102*	Advanced Control System	3	1	0	30	20	50	100		**150**	4
2	(MEET 111/ MEET 112/ MEET 113/ MEET 114)*	1. 1. Renewable Energy Systems 2. Power System Modeling 3. Applications of Power Electronics to Power Systems 4. Hybrid Electric Vehicles	3	0	0	30	20	50	100		**150**	3
3	AHT 310-AHT313/ MOET 395-MOET 398	Open Elective-2	3	0	0	30	20	50	100		**150**	3
4	MEEP101*	Advanced Power Electronics Lab	0	0	3		25	25		25	**50**	1
5	MEEP102*	Advanced Control System Lab	0	0	3		25	25		25	**50**	1
6	MPSP 401	Dissertation (Phase II)	0	0	28			250		-	**700**	14
		Total	9	2	34			450	300	150	**1250**	**26**

*Syllabus same as for Regular M.Tech. 1st Year course

Open Elective-2
AHT310: Business Analytics
AHT311: Industrial Safety
AHT312: Operations research
AHT313: Cost Management of Engineering Projects
MOET-395: Energy Auditing and Management
MOET396: Analysis And Design Of Artificial Neural Network
MOET397: Renewable Power Generation Technologies
MOET398: Power System Restructuring and Pricing

Syllabus
BUSINESS ANALYTICS (AHT- 310)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives

The course should enable the students to:
1. Understanding the Role of Business Analyst in business.
2. Understanding the basic concept of data management and data mining techniques
3. Understanding the basic concept of data management and data mining techniques.
4. To understand the basic concept of machine learning
5. To understand the application of business analysis.

Course Outcomes

Upon successful completion of the course, the student will be able to
1. Gaining Knowledge of basic concept /fundamentals of business analysis.
2. Understand data management and handling and Data Science Project Life Cycle.
3. Understand the data mining concept and its techniques.
4. Understand and Analyzing machine learning concept.
5. Understand the application of business analysis in different domain.

UNIT 1   **(08 Hours)**
Introduction:
What is business analytics? Historical Overview of data analysis, Data Scientist vs. Data Engineer vs. Business Analyst, Career in Business Analytics, What is data science, Why Data Science, Applications for data science, Data Scientists Roles and Responsibility.

UNIT 2   **(08 Hours)**
Data:
Data Collection, Data Management, Big Data Management, Organization/sources of data, Importance of data quality, Dealing with missing or incomplete data, Data Visualization, Data Classification.
Data Science Project Life Cycle: Business Requirement, Data Acquisition, Data Preparation, Hypothesis and Modelling, Evaluation and Interpretation, Deployment, Operations, Optimization.

UNIT 3   **(08 Hours)**
Introduction to Data Mining:
The origins of Data Mining, Data Mining Tasks, OLAP and Multidimensional data analysis, Basic concept of Association Analysis and Cluster Analysis.

UNIT 4   **(08 Hours)**
Introduction to Machine Learning:

History and Evolution, AI Evolution, Statistics Vs Data Mining Vs Data Analytics Vs, Data Science, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Frameworks for building Machine Learning Systems.

UNIT 5   **(08 Hours)**
Application of Business Analysis:
Retail Analytics, Marketing Analytics, Financial Analytics, Healthcare Analytics, Supply Chain Analytics.

Books and References
1. An Introduction to Business Analytics, Ger Koole, Lulu.com, 2019.
2. Essentials of Business Analytics: An Introduction to the methodology and its application, Bhimasankaram Pochiraju, Sridhar Seshadri, Springer.
3. Introduction to Data Science, Laura Igual Santi Seguí, Springer.
4. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education India.

Syllabus
INDUSTRIAL SAFETY (AHT- 311)

L:T:P:: 3:0:0   **Credits-3**

Course Objectives:

 The course should enable the students to:
1. To impart knowledge about various aspects of industrial safety.
2. To impart knowledge about safety and health regulations.
3. To enable the students to identity industrial hygiene and source models.
4. To understand Acts and Rules of industrial safety.
5. To understand the safety management and training.

Course Outcomes:

Upon successful completion of the course, the student will be able to:
1. Identify the key aspects of industrial safety and mitigate them.
2. Describe various types of solution to problems arising in safety operations and hygiene.
3. Apply principles of OSHA in controlling industrial disasters and losses.
4. Identify various Acts and Rules of industrial safety.
5. Assess the overall performance of safety management and training.

UNIT 1   **(08 Hours)**

Introduction:

History of safety movement -Evolution of modern safety concept, Henrich's Axioms Of Industrial Safety, Concepts Of Safety, Organization For Safety, Organization, Definition, Need & Principles Organizing For Health, Environmental, Activities, Organization Structure, Function & Responsibilities.

UNIT 2   **(08 Hours)**

Safety and Health Regulations:

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT 3   **(08 Hours)**

Industrial Hygiene:

Government Laws and Regulations, OSHA: Process Safety Management, EPA: Risk Management Plan, DHS: Chemical Facility Anti-Terrorism Standards (CFATS) Industrial Hygiene: Anticipation and Identification, Evaluation, Control.

Source Models: Introduction to Source Models, Flow of Liquid through Holes, and Pipes, Flow of Gases or Vapors through Holes and Pipes, Flashing Liquids, Liquid Pool Evaporation or Boiling, Conservative Analysis.

UNIT 4   **(08 Hours)**

Acts and Rules:

 Indian boiler Act 1923, static and mobile pressure vessel rules (SMPV). motor vehicle rules, mines act 1952,

workman compensation act and rules, electricity act and rules, the building and other construction workers act 1996, Petroleum rules, Explosives Act 1963 Pesticides Act. Factories Act 1948 Air Act 1981 and Water Act 1974.

UNIT 5 (08 Hours)
Safety Management and Training:

The importance of training - identification of training needs training methods - programs, seminars, conferences. Evaluation of modern safety concepts, safety management functions, safety organization, safety department, safety committee, safety audit, performance measurements, motivation, employee participation in safety, safety, and productivity.

Books and References

1. Safety Management in industry by NV. Krishnan, Jaico Publishing House, Bombay, 1997.
2. Safety at Work by J.R. Ridey Butterwort London 1983.
3. "Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.
4. Occupational Safety Manual BHEL.
5. Safety Manual. EDEL Engineering Consultancy, 2000.

Syllabus
OPERATIONS RESEARCH (AHT- 312)

L:T:P:: 3:0:0   **Credits-3**

Objective of the Course

 The course should enable the students to:
1. To build capabilities in the students for analyzing different situations in the industrial/ business scenario.
2. To understand and analyze managerial and engineering problems.
3. To understand of various assignment problem in Operation research.
4. To introduce students to the various problem of Transportation.
5. To understand of various network techniques in Operation research.

Course Outcomes
Upon successful completion of the course, the student will be able to
1. To analyze any real-life system with limited constraints and depict it in a model form.
2. Ability to understand role of Linear Programming aids decision making.
3. Imparts knowledge of Assignment problem and its uses.
4. Understand variety of problems such as transportation, travelling salesman etc.
5. Understand different queuing situations and find the optimal solutions using models for
   different situations.

UNIT 1   **(08 Hours)**
Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, Features and Phases of Operation Research, Types of Operation Research, Limitations of Operation Research, Role of Operational research in decision making.

UNIT 2   **(08 Hours)**
Linear Programming: Introduction of Linear Programming problem, Requirement of LPP, Applications, Advantages, Limitations, Mathematical Formulation of LPP. Graphical solution, Simplex method for maximization and minimization Problems. Applications to management decision making.

UNIT 3   **(08 Hours)**
Assignment Problem: Introduction to assignment problems, need and significance of assignment problem, Algorithm, Hungarian method, simple assignment problems.

UNIT 4   **(08 Hours)**
Transportation Problems: Introduction, Features, need and significance, formulation of transportation problem, Initial basic feasible solution - NWC, Least Cost, Vogel's and MODI Method.

UNIT 5   **(08 Hours)**

Network Models and Simulation: Network models for Project analysis, Phases of project management, guidelines for network construction, CPM- Network construction and time analysis, PERT- Simple problems, need for simulation and managerial perspective of various quantitative techniques.

Books and References
1. Wayne L. Winston, "Operations Research" Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V. K. Khanna, "Total Quality Management" New Age International, 2008.

Syllabus
COST MANAGEMENT OF ENGINEERING PROJECTS (AHT-313)

L:T:P:: 3:0:0   **Credits- 3**

COURSE OBJECTIVES: The course should enable the students to:

I. Establish systems to help streamline the transactions between corporate support departments and the operating units.

2. Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units. organizational operating units.

3. Use pseudo profit centers to create profit maximizing behavior in what were formerly cost centers.

COURSE OUTCOMES:

1: Understand the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.

2: Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.

3: Understand the meaning and different types of project management and project execution, detailed engineering activities.

4: Understand the project contracts, cost behavior and profit planning types and contents, Bar charts and Network diagram.

5: Analyze by using quantitative techniques for cost management like PERT/CPM.

UNIT-I: INTRODUCTION

Introduction and Overview of the Strategic Cost Management Process. 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.

UNIT-II: PROJECT MANAGEMENT

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents. 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.

UNIT-III: COST BEHAVIOR AND PROFIT PLANNING

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. Costing of service sector. Just-in-time approach, Material Requirement, Planning, Enterprise Resource Planning.

UNIT -IV: TOTAL QUALITY MANAGEMENT
Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V: QUANTITATIVE TECHNIQUES
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation Problems, Assignment problems, Simulation, Learning Curve Theory.

Text Books:
1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.
2. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Reference Books:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster Advanced Management Accounting.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher.

Web References:
1. https://nptel.ac.in/courses/110/101/110101132/
2. https://nptel.ac.in/courses/105104161/

E-Text Books:
1. https://easyengineering.net/construction-engineering-and-management-by-seetharaman/

Syllabus
MOET395: ENERGY AUDITING AND MANAGEMENT

L:T:P:: 3:0:0   **Credits-3**

Course Objectives
The course objectives are:
1. To emphasize the energy management on various electrical equipment and metering.
2. To illustrate the energy management in lighting systems and cogeneration.
3. To study the concepts behind the economic analysis and load management.
4. To study the concepts of Metering for energy management.
5. To study the concepts of Economic analysis by studying various models.

Course Outcomes:
Upon completion of the course, the students will be able to
1. Explain the basics of Energy auditing and Energy management.
2. Employ energy management strategies for electric machines and cogeneration.
3. Employ energy management strategies in lighting systems.
4. Devise energy management strategies for metering and instrumentation.
5. Analyse and justify the economics of different energy management strategies.

Unit 1:
Basics of Energy – Need for energy management – Energy accounting - Energy monitoring, targeting and reporting - Energy audit process.

Unit 2 :
Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

Unit 3 :
Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

Unit 4 :
Metering for energy management – Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters,

metering location vs requirements, metering techniques and practical examples.

Unit 5 :

Economic analysis – Economic models - Time value of money - Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

Reference Books:

1. Barney L. Capehart, Wayne C. Turner, and William J.Kennedy, 'Guide to Energy Management', 5th Edition, The Fairmont Press, Inc., 2006.
2. Amit K. Tyagi, 'Handbook on Energy Audits and Management', The Energy and Resources Institute, 2003.
3. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

Syllabus
MOET 396: ANALYSIS AND DESIGN OF ARTIFICIAL NEURAL NETWORK

L:T:P:: 3:0:0   **Credits-3**

Course Objectives
The course objectives are:
1. To apply artificial neural networks in various electrical and electronics engineering applications.
2. To study different modes of operation in artificial neural network.
3. To study the first generation and second generation neural networks.
4. To study the Neuro adaptive control applications.
5. To study the applications of neural algorithms and systems.

Course Outcomes:

Upon completion of the course, the students will be able to

1. Explain the concepts of biological and artificial neural network.
2. Understand the different modes of operation in artificial neural network.
3. Discriminate the first generation and second generation neural networks.
4. Apply the third generation neural networks.
5. Employ neural network in pattern recognition, forecasting, control, clustering, data mining and decision makingengineering problems.

Unit 1:

Pattern classification – Learning and generalization - Structure of neural networks – Adaline and Madaline - Perceptrons.

Unit 2:
Linear separability – Back propagation – XOR function-Back propagation algorithm - Hopfied and Hamming networks- Kohensen's network - Boltzmenn machine-in and out star network – Art 1 and Art 2 nets.

Unit 3:

Neuro adaptive control applications - ART architecture – Comparison layer – Recognition layer –

ART classification process – ART implementation – Examples.

Unit 4:

Character recognition networks - Neural network control application - connectionist expert systems for medical diagnosis - self-organizing maps.

Unit 5:

Applications of neural algorithms and systems - Character recognition networks, Neural network control application, connectionist expert systems for medical diagnosis.

Reference Books:

1. Martin T. Hagan, Howard B. Demuth, M, and Mark H. Beale ,'Neural network design', Vikas Publishing House,2003.
2. Zurada, J.M., 'Introduction to Artificial Neural Systems', Jaico publishing house, Bombay, 1992.
3. Zimmermann, H.J., 'Fuzzy set theory and its applications', Allied publishers limited, Madras, 2001.

Syllabus
MOET 397: RENEWABLE POWER GENERATION TECHNOLOGIES

L:T:P:: 3:0:0   **Credits-3**

Course Objectives
The course objectives are:
1. To make aware of various forms of renewable energy.
2. To impart knowledge of the wind energy conversion system and photovoltaic conversion system.
3. To convey about the Grid connected PV systems technology.
4. To teach the Components of Energy in the wind.
5. To the Wind turbine generator systems .

Course Outcomes

Upon completion of the course, the students will be able to:

1. discuss the need and possibility of extracting solar energy and converting into electrical energy using PV cell.
2. Design and analyze stand-alone and grid connected PV system.
3. Describe the dynamics of wind turbine and electrical generator.
4. Select and design suitable configuration of the wind energy conversion system based on application.
5. Suggest, design and analyze hybrid energy systems.

Unit 1:
Sun and Earth - Basic Characteristics of solar radiation - Angle of sunrays on solar collector - Photovoltaiccell - characteristics-equivalent circuit - Photovoltaic modules and arrays.

Unit 2:
PV Systems-Design of PV systems - Standalone system with DC and AC loads with and without battery storage - Grid connected PV systems - Maximum Power Point Tracking.

Unit 3:

Wind energy – Energy in the wind – Aerodynamics - Rotor types – Forces developed by blades - Aerodynamic models – Braking systems – Tower - Control and monitoring system - Design considerations- Power curve - Power speed characteristics - Choice of electrical generators.

Unit 4:

Wind turbine generator systems - Fixed speed induction generator - Performance analysis - Semi variable speed induction generator - Variable speed induction generators with full and partial rated power convertertopologies - Isolated systems - Self excited induction generator - Permanent magnet alternator - Performance analysis.

Unit 5:

Hybrid energy systems - Wind-diesel system - Wind-PV system - Micro hydro-PV system - Biomass- PV-diesel system - Geothermal-tidal and OTEC systems.

Reference Books:

1. Chetan Singh Solanki, 'Solar Photovoltaics -Fundamentals, Technologies and Applications', PHI LearningPvt. Ltd., New Delhi, 2011.
2. Van Overstraeton and Mertens R.P., 'Physics, Technology and use of Photovoltaics', Adam Hilger,Bristol,1996.
3. John F. Walker & Jenkins. N , 'Wind energy Technology', John Wiley and sons, Chichester, UK, 1997.
4. Freries L L ,'Wind Energy Conversion Systems', Prentice Hall, U.K., 1990.

Syllabus
MOET 398: POWER SYSTEM RESTRUCTURING AND PRICING

L:T:P:: 3:0:0   **Credits-3**

Course Objectives
The course objectives are:
1. To emphasize on the regulated and deregulated power markets .
2. To study the Electricity Pricing and Forecasting.
3. To study the Components of restructured system.
4. To study the Open Access Distribution.
5. To study the Challenges and synergies in the use of IT in power sector.

Course Outcomes:
Upon completion of the course, the students will be able to

1. Explain the deregulated electricity market models functioning around the world.
2. Understand the operational and planning activities in power generation.
3. Solve transmission pricing and understand strategies in congestion management.
4. Study the development of competition in electricity distribution companies.
5. Outline the salient features of Indian Electricity Act and the formation and operation of Indian power exchanges.

Unit 1 : Introduction – Market Models – Entities – Key issues in regulated and deregulated power markets - Market equilibrium - Market clearing price - Electricity markets around the world.

Unit 2: Operational and planning activities of a Genco - Electricity Pricing and Forecasting - Price Based Unit Commitment Design - Security Constrained Unit Commitment design. - Ancillary Services for Restructuring- Automatic Generation Control (AGC).

Unit 3: Introduction - Components of restructured system - Transmission pricing in Open-access system-Open transmission system operation - Congestion management in Open-access transmission systems - FACTS in congestion management - Open-access Coordination Strategies - Power Wheeling - Transmission Cost Allocation Methods.

Unit 4 : Open Access Distribution - Changes in Distribution Operations - The Development of Competition – Maintaining Distribution Planning.

Unit 5 : Power Market Development – Electricity Act, 2003 - Key issues and solution - Developing power exchanges suited to the Indian market - Challenges and synergies in the use of IT in power - Competition - Indian power market - Indian energy exchange- Indian power exchange- Infrastructure model for power exchanges - Congestion Management - Day Ahead Market - Onlinepower trading.

Reference Books:

1. Loi Lei Lai, 'Power System Restructuring and Deregulation', John Wiley & Sons Ltd., 2001.
2. Mohammad Shahidehpour, Hatim Yamin, 'Market operations in Electric power systems', John Wiley & son ltd.,2002.
3. Lorrin Philipson, H. Lee Willis, 'Understanding Electric Utilities and Deregulation', Taylor & Francis, 2006.
4. Mohammad Shahidehpour, Muwaffaq Alomoush, 'Restructured Electrical Power Systems', Marcel Dekker, Inc.,2001.